Seismic Retrofit of Historic Buildings Workshop, Association for Preservation Technology International
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GLOSSARY OF EARTHQUAKE AND SEISMIC RETROFIT TERMS AND ACRONYMS

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AAM - American Association of Museums

AASLH - American Association for State and Local History

ABK - Joint venture of Agbabian Associates, S.B. Barnes & Associates, and Kariotis & Associates (ABK).

ABK methodology - A methodology for mitigating seismic hazards in unreinforced masonry buildings developed by ABK under a National Science Foundation contract (*see Methodology for Mitigation of Seismic Hazards in Existing Unreinforced Masonry Buildings* in the Bibliography).

abutment - A masonry mass (or the like) which receives the thrust of an arch, vault, or strut (Harris).

ACHP - The Advisory Council on Historic Preservation

acceleragram - Acceleragram is the record from an accelerograph showing acceleration as a function of time [AIA].

acceleragraph - Acceleragraph is a strong motion earthquake recording instrument [AIA].

acceleration - The time rate of change of velocity in either speed or direction (Krakower); when multiplied by mass it results in an inertial force. Acceleration is expressed in g - the acceleration of a free-falling body due to earth's gravity. (Rabeneck and Reaveley)

accelerometer - An electronic sensor to measure the acceleration at a particular location and in a particular direction (Atkinson).

action - Any gent (forces, deformations, etc.) which directly or indirectly produces stresses into a building structure and any phenomenon (chemical, biological, etc.) which affects the materials of which the building structure is composed. The different categories of actions and their definitions are give in the "Guidelines" (ISCARSAH).

adaptive use, adaptive reuse - Act or process of adapting or converting a building to a use other than that for which it was designed, e.g., changing a factory into housing. Such conversions are accomplished with varying degrees of alterations to the building. The more change that is necessary, the less likely that particular new use is appropriate for a historic building.

adobe - Large, roughly molded, sun-dried brick is one of the oldest and most common building materials known to man. Traditionally, adobe bricks were never kiln fired. Unbaked adobe bricks consisted of sand, sometimes gravel, clay, water, and often straw or grass mixed together by hand, formed in wooden molds, and dried by the sun. The composition varies from site to site because most adobe bricks were made from the locally available earth (NPS).

adobe - An outdoor air-dried, unburned brick made from a clayey soil and sand that is usually mixed with straw or animal manure. The clay content of the soil ranges from 10 to 30 percent (GSAP).

adobe - Adobe are bricks made from clay and simply dried in the sun. Some organic materials like straw or animal excrement can be used to improve durability or reduce shrinkage (ISCARSAH).

aftershock - One of many smaller earthquakes along the same fault line or in the same general area following a major earthquake.

AIA - American Institute of Architects

AIA - Archaeological Institute of America

AIC - American Institute for Conservation of Historic and Artistic Works

allowable stress (working stress) - In the design of structures, the maximum unit stress permitted under working loads. If a member is so designed that the maximum stress as calculated for the expected conditions of service is less than some certain value, the member will have a proper margin of security against damage or failure. This certain value is the allowable stress of the kind and for the material and condition of service in question. The allowable stress is less than the damaging stress because of uncertainty as to the conditions of service, non-uniformity of material, and inaccuracy of stress analysis (Roack).

American National Standards Institute - An independent organization of trade associations, technical societies, professional groups, and consumer organizations; establishes and publishes standards; formerly known as the United States of America Standards Institute (USASI or ASI), and previously as the American Standards Association (ASA).

American Society for Testing Materials (ASTM) - A nonprofit organization that establishes standard tests and specifications for construction materials; such tests and specifications usually are referred to by the abbreviation ASTM followed by a numerical designation.

amplification - The increase in earthquake ground motion that may occur to the principle components of seismic waves as they enter and pass through different earth materials [AIA].

amplitude - The extent of movement or departure of a measured physical quantity from a mean value of zero (Atkinson). The maximum value of the displacement in an oscillatory motion; the extreme range of a fluctuating quantity, as an alternating current, pendulum, wave, etc., generally measured from the average or mean to the extreme. Amplitude is the maximum deviation from mean or center line of a wave.

anamnesia - The account of the case history of a building, including past traumas, interventions, modifications, etc. The research to acquire this information prior to examination. This is the first step prior to diagnosis. See **control**, **diagnosis**, and **therapy** (ISCARSAH).

anchor, anchorage - A device such as a metal rod, wire, or strap, for fixing one object to another; specially formed metal connectors used to fasten together timbers, masonry, trusses, etc.; in seismic design a device to connect floor or roof systems to unreinforced masonry walls (Harris).

ANSI - American National Standards Institute.

analytical model - Mathematical model used to analyze a building (Hart).

anta - A pier or pilaster formed by a thickening at the end of a wall; its capital and base differ from those of the columns forming part of the same order. Antae often occur in pairs on either side of a doorway or beyond the face of the end walls (Harris).

APT - Association for Preservation Technology.

APTI - Association for Preservation Technology International.

arch - A curved construction which spans an opening; usually consists of wedge-shaped blocks call **voussoirs**, or a curved or pointed structural member which is supported at the sides or ends. Arches vary in shape from semicircular and semi-elliptical to bluntly or acutely pointed arches (Harris)

archaic construction - Construction developed during and/or belonging to an earlier period and is no

longer in common use in new construction. Archaic materials often have tested capacities and can be used effectively as part of lateral load resisting systems.

archaic material - Construction materials common in an earlier period, e.g., unstabilized adobe, terra cotta, sandstone, cast iron, wrought iron, plaster on wood lath, etc., which are not common in new construction although they may be still available.

archaic structural systems - Structural system developed or belonging to an earlier period and is not common in new construction, e.g, a frame of cast-iron columns and wrought-iron I beams.

architectural conservation - The science of preserving architecture and its historic fabric by observing and analyzing the evolution, deterioration, and care of structures; the conducting of investigations to determine the cause, effect, and solution of structural problems; and the directing of remedial interventions focused on maintaining the integrity and quality of historic fabric (SHBC).

architectural heritage - Buildings and complex of buildings (towns, etc.) of historical value. See **building** (ISCARSAH).

architectural terra-cotta - A hard-burnt, glazed or unglazed clay unit used in building construction; plain or ornamental; machine extruded or hand-molded; usually larger in size than brick or facing tile. See also **ceramic veneer**.

architrave - In the classical orders, the lowest member of the entablature; the beam that spans from column to column, resting directly upon their capitals (Harris).

artstone - A building material made of a mixture of cement, sand, hydrated lime and water cast in a plastic condition in suitable molds. The finished units are attached to the building as part of the architectural finish (Krakower).

artifact - An object showing human workmanship or modification (SHBC).

artificial stone - A mixture of stone chips or fragments, usually embedded in a matrix of mortar, cement, stucco, or plaster; the surface may be ground, polished, molded, or otherwise treated to simulate stone; variously called art stone, art marble, artificial marble, cast stone, marezzo, patent stone, and reconstructed stone.

ASCE - American Society of Civil Engineers

ASLA - American Society of Landscape Architects

ASTM - American Society for Testing Materials.

aseismic - Anti-seismic or against lateral motion (Kimbro).

aseismic isolation system - A system to minimize the transmission of potentially damaging earthquake ground motions into a structure, see **base isolation** (Kelly).

aseismic region - A region that is relatively free of earthquakes.

ATC - Applied Technology Council.

attenuation - Reduction in amplitude or change in wave due to energy dissipation or distance with time [AIA].

attenuation - The decrease in the magnitude or value of a quantity often as a function of time or space (Atkinson). A decrease in earthquake intensity due to loss of energy; such as that due to length of travel path of transfer or energy from the earth to a building's foundation (Kariotis). Diminish or lessen, for example, crosswalls function in a building to lessen the horizontal displacements of roofs and floors. The crosswalls attenuate the displacement (Krakower).

authenticity is the condition or quality of being authentic, trustworthy, or genuine [The American

Heritage Dictionary of the English Language].

authenticity - The quality of having undisputed origin (SHBC).

axial load - Force in line with primary axis of a member.

baluster - One of a number of short vertical members, often circular in section used to support a stair, porch, or balcony handrail or a coping (Harris).

balustrade - An entire railing system (as along the edge of a balcony) including a top rail and its balusters, and sometimes a bottom rail (Harris).

barrel vault - A masonry vault of plain, semicircular cross section, supported by parallel walls or arcades and adapted to longitudinal areas (Harris).

basal erosion - A coving-type of deterioration at the base of an adobe wall. Usually caused by water (GSAP).

base isolation - A principle to minimize the transmission of potentially damaging earthquake ground motions into a structure. This is achieved by the introduction of flexibility at the base of a structure--in the horizontal plane -- so that it can "roll with the punch." In addition, damping elements are introduced to restrict the amplitude or extent of the motion caused by the earthquake--somewhat akin to shock absorbers. The concept of isolating structures from the damaging effects of earthquakes is not new. The first patent for a base isolation scheme in the United States was taken out in l909, and since that time several proposals with similar objectives have been made. Nevertheless, until very recently, few structures have been designed and built using these principles because of practical difficulties with the isolation schemes and their hardware (Dynamic Isolation Systems). It is now being used for existing buildings. The first historic building to be base isolated in the United States is the Salt Lake City and County Building.

base shear - The total shear force acting at the base of a structure. The total of the earthquake loads prescribed by the code or ordinance. A dynamic base shear may be calculated by an elastic analysis or a nonlinear analysis. The dynamic base shear is the total of the forces that causes the dynamic displacement of the building relative to the base. If the analysis is an elastic analysis, the base shear is for the equivalent elastic system, not the yielding system (Kariotis).

battering - Collision of closely spaced building elements during an earthquake (Krakower).

Bauschinger Effect - Under loading, the yield strength of metal is increased in the direction of initial loading and decreased in the opposite direction. Repeated loading and unloading eventually causes weakening in the opposite direction, leading to failure.

beam - A structural member whose prime function is to carry transverse loads, as a joist, girder, rafter, or purlin (Harris).

beam pocket - An opening in a vertical structural member, such as a masonry wall, to receive an end of a beam (Harris). In masonry, the opening is constructed by leaving out bricks in this area. In heavy timber construction the opening is usually a **mortise**.

balloon frame, balloon framing, balloon frame construction - A system of framing a wooden building where all vertical structural elements of the exterior walls and partitions consist of light single studs (usually 2x4, but sometimes larger) which may extend the full height of the frame and are fastened by nails to the studs. Studs are load bearing in a wall system different than post and beam where the wall is not structural. Balloon framing differs from a braced frame in that a balloon framed wall acts as a bearing wall not relying on posts and beams to support joists (Cliver).

bilinear - Representation by two straight lines of the

properties of a material.

bond beam - Poured-in-place reinforced concrete installed at the top of an unreinforced masonry wall to tie the walls together and to provide secure anchorage for the roof structure (Krakower).

bond bean - A wood or concrete beam added to the top of a [adobe] wall at the roof level around the perimeter of a building (GSAP).

bond course - A course of headers or bondstones to bond the facing masonry to the backing masonry (Harris).

braced frame, braced framing - The frame of a building in which the resistance to lateral forces or to a frame instability is provided by diagonal bracing, chevron bracing, or other type of bracing (Kariotis). Braced frame is one in which lateral forces are transmitted through bracing members such as shear walls and diagonal braces.

brick - A brick is a masonry unit usually made of clay which can be fired or simply dried in the sun (ISCARSAH).

brick masonry - Brick masonry is a composite structure of material made of alternating brick and mortar courses (ISCARSAH).

boundary zones for shear wall - Specially reinforced zones at the two ends of the shear wall (Fatehi).

brick - A solid or hollow masonry unit of clay or shale, molded into a rectangular shape while plastic, and then burnt in a kiln (Harris).

brittle - Description of a material which fractures without appreciable deformation (Kariotis).

buckling - General or local failure in a member or building either by elastic or plastic deformation.

building - Any structure or edifice used or intended for supporting or sheltering any use or occupancy (SHBC). Building usually is for human occupancy or habitation as opposed to a structure such as a bridge or a dam.

building Something that is built. When used in context of the ISCARSAH "Recommendations," the term encompasses churches, temples, bridges, dams, and all constructions. As well as buildings for occupation. Also referred to as **architectural heritage** (ISCARSAH).

buttress - An exterior mass of masonry set at an angle to or bonded into a wall which it strengthens or supports; buttresses often absorb lateral thrusts from roof vaults (Harris).

CALBO - California Building Officials

canales - Hollowed log drains through adobe parapet walls. See also ***gargolas*** (NPS).

capital - The topmost member, usually decorated, of a column, pilaster, anta, etc. It may carry an architrave or an arcade or be surmounted by an impost block (Harris).

cast iron - An iron alloy, which includes carbon and silicon; a large range of building products are made of this material by pouring the molten metal into sand molds and then machining. Has high compressive strength, but low tensile strength.

catalysis - The causing or speeding up of a chemical reaction by the addition of some substance which itself undergoes no permanent chemical change.

catalyst - Any substance serving as the agent in catalysis.

catastrophic collapse - Unrepairable damage to a building or structure (Cliver).

cedros - Handsplit cedar planks used in the construction of floors and roofs in adobe buildings, if available. See also ***savinos*** (NPS).

CenterCore - A trademarked technique of vertically coring unreinforced masonry and grouting conventional steel reinforcing rods in place for reinforcement of the masonry to resist in-plane shear and out-of-plane bending (Breiholz, see Bibliography and paper).

center core rods - Steel or reinforced polymer rods that are inserted vertically in drilled holes in adobe walls. The rods are used to minimize the relative displacement of cracked wall sections. Rods are set in a polyester, epoxy, or adobe grout (GSAP).

certified historic structure - Any building listed individually on the National Register of Historic Places, or located in a registered historic district and certified as being of historic significance to the district by the National Park Service, Department of the Interior. For purposes of the Tax Incentives for Historic Buildings, it must also be depreciable.

certified rehabilitation - Any rehabilitation of a **certified historic structure** that is certified as being consistent with the historic character of the property and, where applicable, the district in which it is located. Each rehabilitation is evaluated by the **National Park Service** using the **Secretary of the Interior's *Standards for Rehabilitation*** after considering the recommendations of the **State Historic Preservation Officer**.

chancel - The sanctuary of a church, including the choir; reserved for the clergy (Harris).

collar beam, spanpiece, sparpiece, top beam, wind beam - A horizontal member which ties together (and stiffens) two opposite common rafters, usually at a point about half-way up the rafters in a collar beam roof (Harris).

collar beam roof, collar roof - A roof supported by rafters tied together by collar beams (Harris).

collar joint - The joint between a roof rafter and a **collar beam**; the vertical joint between masonry **wythes** (Harris).

collar joint - The space between wythes, space which may be empty or may be filled with mortar. Although the condition of the joint may not be critical for in-plane wall shearing stress, the provisions for determining allowable stress from in-place shear tests take into account the probable effect of mortar in the joint. The condition of the joint is of greater importance for out-of-plane forces it is necessary to have the wythes of the wall act integrally.

colonnade - A number of columns arranged in order, at intervals called intercolumniation, supporting an entablature and usually one side of a roof (Harris).

common rafter, intermediate rafter, spar - A rafter which is at right angles to the **rafter plate** (at the eaves) of a roof and extends from the plate to the **ridge board** or **ridge pole** (Harris).

compatibility - Harmony of materials used in strengthening and repairs. These materials must be strong enough for their task but not too strong. If too strong, the new material will throw greater stress on the old and cause its destruction. After an earthquake one may find that the strengthening measures survive (in some form) but that the historic fabric has disintegrated. Tensile reinforcement in masonry buildings is much preferred to "jacketing" in reinforced concrete, particularly as it does not alter its overall weight (Feilden)

compatibility is the principle that no treatment shall detract from or cause damage to a cultural resource. This includes both visual and physical compatibility. Treatments and new work shall be visually compatible in terms of design, color, texture, massing, size, scale, and other visual qualities to protect the historic integrity of the property and its environment. Likewise, the treatments and new work shall physically compatible with the historic materials in terms of coefficients of expansion and contraction with changes in temperature, shrinking and swelling with changes in moisture, hardness, etc.

[Look].

compatibility - Harmony of materials used in strengthening and repairs. These materials must be strong enough for their task but not to stiff (Kariotis); combination of materials which must deflect equally and share load in proportion to their stiffness and strength (Krakower).

compatibility - Compatible elements are those that have similar load-deflection characteristics. When incompatible elements are combined in the same system, large forces can be generated between the incompatible members as the system deforms. In an adobe wall, the incorporation of incompatible materials, such as brick masonry or portland cement infills, may induce failure that typically would not occur if the infills were of adobe. The difference in the modulus of elasticity of adobe and that of either wood or concrete is approximately one order of magnitude (GSAP).

compression - The state of being compressed, or being shortened by a force.

compressions and dilations - Contracting or expanding changes in area due to strain.

compressive strain - The change in length produced in a test specimen by a compressive load.

concealed anchors - Bolts or rods with a specified capacity installation embedded in a cylinder of polyester resin epoxy drilled into an unreinforced masonry wall with a specified length. The anchor is not visible when the installation is completed (Krakower).

confinement of concrete - Concrete in a column is confined by use of vertical or spiral reinforcing bars.

conservation - Act or process of conserving; protection from loss, waste, or destruction; preservation; the official care and protection of natural and cultural resources.

control - A standard of comparison for checking the results of an experiment. To verify and regulate the efficiency of an enacted therapy through test, monitoring and examination. See **anamnesis**, **diagnosis**, and **therapy** (ISCARSAH).

convergence zone - A band along which moving plates collide and area is lost either by shortening and crustal thickening or subduction and destruction of the earth's crust.

corbel - In masonry, a projection or one of a series of projections, each stepped progressively farther forward with height; anchored in a wall, story, column, or chimney; used to support an overhanging member above or, if continuous, to support overhanging courses; may support an ornament of similar appearance; a projecting stone which supports a superincumbent weight (Harris).

core - The central part of the earth, which is thought to be composed of iron and nickel and to be molten on the outside with a central solid inner core.

coring - Act or process of taking a core sample for testing; usually by drilling; act or process of removing an area of masonry in order to install an anchor bolt and grout it in place.

cornice - The exterior trim of a structure at the meeting of the roof and wall or at the top of the wall in the case of a parapet, usually consisting of bed molding, soffit, fascia, and crown molding; any molded projection which crowns or finishes the part to which it is affixed; the third or uppermost division of an entablature, resting on the frieze; an ornamental molding, usually of wood or plaster, running round the walls of a room just below the ceiling; a **crown molding**; the molding forming the top member of a door or window frame (Harris).

cost benefit analysis - Cost and benefits refer to general rather than monetary terms. Costs can be measured also in the potential loss of fabric due to the invasiveness of the therapy, and benefits can be those gained by the therapy as well as knowledge that

will prove useful in the future. This terms should not be interpreted as "value engineering" (ISCARSAH).

CPF - California Preservation Foundation

cracked wall section - A section of an adobe wall that is defined by a boundary of through-wall cracks (GSAP).

creep (along a fault) - Very slow periodic or episodic movement along a fault line trace unaccompanied by earthquakes.

creep (of a building material) - The continuing, time-dependent part of strain resulting from stress; the permanent and continuing dimensional deformation of a material under a sustained load, following the initial instantaneous elastic deformation; in structures, particularly of concrete and wood, permanent deflection of structural framing or structural decking resulting from plastic flow under continued stress.

cripple-timber (jack-timber) - In a building frame, a structural element that is shorter than usual, as a stud above a door opening or below a window sill (Cliver).

cripple wall - A short wall supporting a house or building usually over a crawl space and transmits the loads of the structure to the foundation.

critical damping - The minimum damping that will allow a displaced system to return to it initial position without oscillation.

critical damping - Damping can exist in a system to dissipate energy and reduce the amount of oscillation which takes place. Generally this is assumed to be proportional to the velocities of the masses and is referred to as viscous damping. Starting from zero damping, this damping can be gradually increased until the masses return to the mean position at rest, having made one oscillation. The minimum amount of damping required to achieve this is the critical damping (Kariotis).

cross braced system - X-braced system consisting of two diagonal members tying opposite sides of a structural frame; structural system consisting of cross or diagonal braces (Fatehi).

crosswall - A wood stud wall that extends continuously from floor system to floor system and is sheathed with new or existing materials. Wood framed walls with nail fastened materials have a desirable hysteretic behavior and can be their coupling strength cause adjacent diaphragms of different stiffness to have nearly the same relative displacement. They function as energy dissipators when connecting diaphragms or a diaphragm to grade within the center of the span of the diaphragm. They act similar to "shear" walls to the extent that they diminish the displacement of a floor or roof relative to the building base, but are not true shear walls. Their in-plane stiffness is not comparable with shear walls of masonry, concrete or lateral load resisting elements of structural steel. Moment resisting frames may be designed as crosswalls or shearwalls (UBC). Whether originally load bearing or non-load bearing, crosswalls are frequently the only structure that supports the roof after the collapse or partial collapse of unreinforced masonry bearing walls during an earthquake (Kariotis). In the special procedures for building analysis in Appendix A of the UCBC, a crosswall is a wall that interconnects levels of horizontal diaphragms. Cross walls can be sheathed in plaster on wood or metal lath, plaster or gypsum lath, gypsum wallboard, plywood or wood studs, drywall or plaster over wood studs. Interconnection of existing crosswalls to diaphragms may be by nominal connections and by finish materials (plaster, sheetrock, etc.). A crosswall is not a shearwall (Cocke and Bonneville).

cupola - A domical roof on a circular base, often set on the ridge of a roof (Harris).

crust - The lithosphere, the outer 50 miles (80.5 kilometers) of the earth's surface made up of crustal rocks, sediment, and basalt. General composition is silicon-aluminum-iron.

CUSEC - Central United States Earthquake Consortium

decay - Change or worsening of the materials characteristics produced by chemical actions. Chemical deterioration related to the breakdown of the materials of which a structural system is composed. Loss of quality, wasting away, decayed tissue (ISCARSAH). See **damage**.

damage - Change and worsening of the structural behavior produced by mechanical actions. Reduction of the mechanical bearing capacity related to the breakdown of a structural system (ISCARSAH). See **decay** and **structure**.

damped harmonic motion - See harmonic motion, damped.

damping - The gradual reduction in oscillation or swaying due to absorption of energy by elastic resistance of materials.

damping - Progressive reduction in amplitude of free vibrations. Any building system has some degree of damping. It is difficult to estimate damping, but whatever it is, it is normally expressed as a percentage of critical damping (Kariotis).

deflection - Displacement of a structural member due to application of external force.

deflection - Any displacement in a body from its static position, or from an established direction or plane, as a result of forces acting on the body; the deformation of a structural member as a result of loads acting upon it (Harris).

deformation - Any change of form, shape, or dimensions produced in a body by a stress or force, with rupture (Harris).

depths of foci - Earthquakes are commonly classed by the depth of the focus or hyocenter beneath the earth's surface: shallow (0.70 kilometers), intermediate (70-300 kilometers), and deep (300 to 700 kilometers).

design life - Length of time that the building is presumed to remain functional (Hart).

diagnosis - The act or process of identifying or determining the nature and cause of damage and decay through, observation, investigation, and historical analysis, and the opinion derived from such activities (ISCARSAH). See **anamnesis**, **control**, and **therapy**.

diaphragm - A member, such as a floor or roof system, which transmits loads by shear action lying in the plane of the member.

diaphragm - A floor or roof that provides lateral support for the out-of-plane walls and transfers the inertial earthquake loading of the floor or roof and the out-of-plane walls to the shear walls (Kariotis).

diaphragm - A large, thin structural element, usually horizontal, that is structurally loaded in its plane. It is usually an assemblage of elements that can include roof or floor sheathing, framing members to support the sheathing, and boundary or perimeter members (GSAP).

diagonal sheathing - Commonly one or two inch thick continuous boards laid across supports at an angle that is not 90 degrees to the support. The boards can be nailed, stapled, or screwed to the supports. Most commonly used for floors in unreinforced masonry buildings though there are instances where it is used for roofs (Krakower).

diagonal tensile cracking - The diagonal or "X"-shaped cracking observed in building walls as a result of a system of loads having high shear loads relative to bending loads (Atkinson).

differential settlement - Relative movement of different parts of a structure caused by deformation of the soil (Krakower).

discontinuity - Not having continuity in the structural system (Fatehi).

dispersion - The dependence of the propagation velocity on wave length or frequency which causes the shape of a disturbance to change continually as time goes on. In an unlimited medium, there will be a continual spreading out of the disturbance into trains of waves.

displacement - The difference between a later position of a element or member and its original or previous position (Cliver). Also see deformation and deflection.

displacement - Offset of an adobe block from the plane of a damaged wall (GSAP).

distinct hazard - Means any clear and evident life-threatening hazardous condition that could occur if some other event such as an earthquake with some defined intensity or windstorm with some defined velocity occurs. Conditions that do not meet prevailing code requirements or that could represent a potential hazard do not constitute a distinct hazard in and of themselves. Term may be applied as in "distinct fire hazard: or "distinct safety hazard," etc. on the same basis (SHBC).

divergence zone - A belt along which plates move apart and new crust is created.

documentation - Act or process of recording a historic structure or portion of a historic structure through graphic (measured drawings, photographs, photogrammetry, rectified photographs, mapping) and written historical and descriptive data. HABS/HAER standards for documentation are widely recognized as national standards for quality and permanence of documentation.

documentation - Documentation consists of drawings, photographs, writings, and other media that depict cultural and natural resources [National Park Service].

dosseret - See **impost block**.

drift - In buildings, the horizontal displacement of basic building elements due to lateral earthquake forces.

drilled concrete pier - Type of foundation system where one drills into the soil, removes the soil, and replaces it with reinforced concrete (Fatehi).

ductile - Capable of being stretched or deformed without fracturing while becoming progressively more resistant to such change (Cliver).

ductility - Ability of a material to withstand strain without fracturing.

dynamic - Properties of soils and buildings which affect the response of soils and buildings to cyclic (non-static) loading conditions.

dynamic analysis - The analysis of a structural system as a function of displacement under transient loading conditions (Harris).

earthen architecture - Building constructed of adobe or rammed earth.

earthquake - The shifting of the earth's crust which can result in devastating destruction (Feilden).

earthquake load - The load specified in the code for analysis of an existing structural member for design of a supplemental structural member; the equivalent lateral force exerted on a structure by an earthquake as specified by a code (Krakower).

Economic Recovery Act of l981 - Section 212 of this act provided a 25% investment tax credit for the certified rehabilitation of a certified historic structures; supplanted the Tax Reform Act of l976 and the Revenue Act of l978; the benefits of the Economic Recovery Act of l981 were amended down by the Tax Reform Act of l986, see **Tax Incentives for Historic Buildings**.

EERC - Earthquake Engineering Research Center

EERI - **Earthquake Engineering Research Institute**.

effective peak acceleration (EPA) - EPA can best be understood by considering it as a normalizing factor for construction of smoothed elastic response spectra (Newmark and Hall, 1969) for ground motions of normal duration. The EPA is proportional to spectral ordinates for periods in the range of 0.1 to 0.5 second. The ratio (for a 5 percent damped spectrum) of the spectral response ordinate in the appropriate period to the EPA is set a standard value of 2.5. For a specific actual ground motion of normal duration, EPA can be determined as follows: The 5 percent damped spectrum for the actual motion is drawn and fitted by a straight line in the period mentioned above. The ordinates of the smoothed spectrum then are divided by 2.5 to obtain EPA. The EPA thus obtained is related to peak ground acceleration but is not necessarily the same as or even proportional to peak acceleration. When very high frequencies are present in the ground motion, the EPA may be significantly less than the peak acceleration. This is consistent with the observation that chopping off the highest peak in an acceleration time history has very little effect on the response spectrum computed from that motion, except at periods much shorter than those of interest in ordinary building practice. Furthermore, a rigid foundation tends to screen out very high frequencies in the free-field motion (Kariotis).

efflorescence - An encrustation of soluble salts, commonly white, deposited on the surface of stone, brick, plaster, or mortar; usually caused by free alkalies leached from mortar or adjacent concrete as moisture moves through it (Harris).

elastic - Descriptive of a material having the property of **elasticity**.

elastic constant - See **modulus of elasticity**.

elastic deformation - A change in shape without impairment of the elastic properties of a material.

elastic design - A method of analysis in which the design of a structural member is based on a linear stress-strain relationship, assuming that the working stresses are only a fraction of the elastic limit of the material.

elastic response - Dynamic motion of a model that is reversible and that does not result in cracks (GSAP).

elasticity - The property of a body that causes it to tend to return to its original shape after deformation (as stretching, compression, or torsion) or form or condition after a displacing force is removed.

elastic limit - The greatest stress which a material is capable of sustaining without permanent deformation upon complete release of the stress.

elastic modulus - Same as **modulus of elasticity**.

elastic range - The portion of the elastic curve below the elastic limit.

elastomer - A macromolecular material (such as rubber or a synthetic material having similar properties) that returns rapidly to approximately the initial dimensions and shape after substantial deformation by a weak stress and release of the stress (Harris).

elastomeric - Said of any material having the properties of an **elastomer**, such as a roofing material which can expand and contract without rupture (Harris).

elastophastic - Gradual transition from elastic to plastic range; total range of stress.

elevation - A drawing showing the vertical elements of a building, either exterior or interior, as a direct projection of the vertical plane; also used for the exterior walls of a building other than the facade (front); the vertical distance above or below some established reference level.

energy absorption - Deformation of a structure as energy is absorbed by distortion.

energy dissipation - Reduction in intensity of earthquake shock wave with time and distance, or by transmission through different materials

EPGA - Estimated Peak Ground Acceleration (GSAP).

epicenter - The point on the earth's surface immediately above the focus or hypocenter of the earthquake (*Consulting Engineer,* May l978).

epicentral distance - The distance from an observation station to the epicenter (*Consulting Engineer,* May l978).

equivalent compression strut - A mathematical representation of an area of an infilled material (concrete or masonry) within a steel or concrete frame based upon the strength of the materials of the filler and frame. The strut stiffens the frame by its capacity to resist frame deformation (Krakower).

examination - The visual portion of an investigation that excludes material testing, structural analysis, structural testing, and other more sophisticated investigative techniques (ISCARSAH). See **investigation**, **material testing**, **structural analysis**, and **structural testing**.

explanatory report - A report that specifically defines the subjective aspects involved in a safety assessment, such as uncertainties in the data assumed, and the difficulties in a precise evaluation of the phenomena that may bead to conclusions of uncertain reliability (ISCARSAH).

exposed washer plate - Visible steel plates with a specified surface area and thickness that are connected to a bolt or rod in an unreinforced masonry wall. The bolt is anchored into a floor or roof to prevent the wall from separating from the building during an earthquake. The plate can be of any shape as long as it has sufficient surface area to contact against the wall (Krakower).

extended use - Any process that increases the useful life of an old building, e.g., adaptive reuse or continued use.

fabric - The structural and material portions that make up the building (frames, walls, floors, roof, etc.) (ISCARSAH).

facade - The exterior face of a building which is the architectural front, sometimes distinguished from the other faces by elaboration of architectural or ornamental details (Harris).

facsimile - An exact visual copy of a qualified historical building. Any material or method may be used to provide an exact copy of the original appearance. (Explanatory note: True facsimiles, or portions of buildings that are true facsimiles, are historically correct and may be constructed utilizing this code (SHBC). For buildings, see **reconstruction**.

failure - a function of both capacity and load; occurs when a member of moderately low strength is loaded with a very high level of load or a very low strength member is loaded with a moderately high load (Hart).

failure mode - The manner in which a structure fails (column buckling, overturning of the structure); or ground failure.

fault -Planer or gently curved fracture in the earth's crust across which there has been relative displacement.

fault - In geology, a break in rock strata or veins where movement has taken place. Faults are generally classified by the type of movement that has occurred; up, down, sideways (Krakower).

fault line - Line of fracture along a **fault**.

fault system - A grouping of related **fault lines**.

fault zone - Instead of one single clear fracture, the fault zone is hundreds or thousands of feet wide; the fault zone consists of numerous interlacing small faults.

faulting - The movement which produces relative displacement of adjacent rock masses along a fracture.

FEMA - Federal Emergency Management Agency.

felt area - Total area of where an earthquake is felt.

fenestration - The arrangement and design of windows in a building (Harris).

fired bricks - A fired brick is a ceramic material obtained by preparation, molding (or extrusion) of raw material (clay) and subsequent drying and firing at an appropriate temperature (ISCARSAH).

first or fundamental mode - The first, or fundamental, mode in which greater displacements are observed further from the fixed base.

flange - A projecting collar, edge, rib, rim, or ring on a pipe, shaft, or the like; the principal longitudinal components (top and bottom) of a beam or girder which resists tension or compression; the flanges of a beam or girder are connected by and are held a specified distance apart by the **web** (Harris).

flat arch, jack arch, straight arch - An arch with a horizontal or nearly horizontal **intrados**; has little or no convexity (Harris).

flatjack - A thin steel envelope that is pressurized with a fluid to apply a uniform stress over the projected area of the flatjack (Harris)

flexible system - A building system with very little resistance to forces; it has ability to absorb energy without failure.

flexure - Bending (GSAP).

flexural center - See **shear center**.

flexural diaphragm - A diaphragm of wood construction with nail fastened sheathing. A steel decking diaphragm not fastened for seismic loading can also be considered a flexible diaphragm. concrete filled steel deck systems or concrete floor systems are not flexible diaphragms.

flexural rigidity - A measure of stiffness of a structural member; the product of the modulus of elasticity and moment of inertia divided by the length of the member (Harris).

flexural strength - That property of a solid which is an indication of its ability to withstand internal tension and compression stresses (Harris).

flexure - The bending of a member under a load (Harris).

flexure stress - **Stress** in a member caused by bending.

flexural stresses - Stresses in a[n] object that result from bending (GSAP).

flute - A groove or channel, especially one of many such parallel grooves, usually semicircular or semielliptical in section; used decoratively as along the shaft of a column (Harris).

focal depth - Depth of an earthquake forcus (or hypocenter) below the ground surface.

focus - The point within the earth's crust or hypocenter at which first rupture is estimated to have occurred. The focus is typically about 20-30 km (12.4 to 18.6 miles) below the earth's surface. The focus marks the origin of the elastic waves of an earthquake.

footing - That portion of the foundation of a structure which transmits loads directly to the soil; may be the widened part of a wall or column, the spreading

courses under a foundation wall, a foundation of a column, etc.; used to spread the load over a greater area to prevent or reduce settling (Harris).

foreshocks - One of several smaller earthquakes preceding a larger earthquake.

foundation - See footing; any part of a structure that serves to transmit the building load to the earth or rock, usually below ground level (Harris).

Fourier spectrum - A ground motion trace of time against acceleration, velocity, or displacement can be broken down into a Fourier series of functions of period or frequency. A replot of these responses against period for a given disturbance is called a Fourier spectrum for that particular disturbance (*Consulting Engineer,* May l978).

frame - A structural system consisting of columns, beams, girders, and rafters or trusses.

frame building - A building in which the frame (columns, beams, girders, and rafters or trusses) carries the loads of the building, as opposed to a bearing wall building in which the walls and carry the loads of the building.

frame with infill wall building - A steel or concrete frame building having non-load-bearing walls constructed in the plane of the frame at the exterior wall.

free oscillation vibrations - The "ringing" or periodic deformation of the whole earth at characteristic low frequencies after a major earthquake.

free-standing walls - Walls, such as garden walls, that are only supported laterally at the ground level. They have not attached roof or floor framing (GSAP).

frequencey - The number of seismic wave peaks which pass through a point in the ground in a unit of time, usually measured in cycles per second.

frieze - The middle horizontal member of a classical entablature, above the architrave and below the cornice; a similar decorative band in a stringcourse, or near the top of an interior wall below the cornice (Harris).

fundamental period - The longest period (duration in time of one full cycle of oscillatory motion) for which a structure or soil column shows a response peak, commonly the period of maximum response.

gable - The vertical triangular portion of the end of a building having a double-sloping roof, from the level of the cornice or eaves to the ridge of the roof (Harris).

gable end - An end wall having a **gable**.

gable roof - A roof having a **gable** at one or both ends (Harris); a roof with two slopes intersecting at a higher point usually located midway between the lower ends (Krakower).

gambrel roof, gambrel - (USA) A roof which has two pitches on each side; in Great Britain called a **mansard roof**; (British) A roof which has a small gable near the ridge on one end; the part of the roof below the gable is inclined (Harris).

gel time - Time for a gel to harden from a jelly-like consistency to a solid.

geometrical survey - Survey sheets, measured drawings (plans, elevations, sections, etc.) where the geometry of the building is identified (ISCARSAH).

girder - A large or principal beam of steel, reinforced concrete, or timber; used to support concentrated loads at isolated points along its length (Harris).

Gothic arch - A loose term denoting a pointed arch (Harris).

graben (rift valley) - A graben is a usually elongated

depression of the earth's crust between two parallel faults. It appears as a long, narrow trough bound by one or more parallel normal faults. Down-dropped fault blocks are caused by tensional crust forces pulling apart.

gravity (g) - The force that tends to draw all bodies in the earth's sphere toward the center of the earth; the rate of acceleration of gravity is approximately 32 feet per second per second (ft/sec^2); abbreviated g (no period).

groin - The ridge, edge, or curved line formed by the intersection of the surfaces of two intersecting vaults (Harris).

groined vaulted, groin vault - A compound vault in which **barrel vaults** intersect, forming arrises called **groins** (Harris).

ground acceleration - Horizontal acceleration of the ground due to earthquake forces.

ground displacement - The distance which the ground moves from its original position during an earthquake.

ground failure - A situation in which the ground does not hold together such as in landslides, mud flows, liquefaction and the like.

ground motion - Lateral or vertical movement of the ground, such as in earthquakes (GSAP).

ground movement - A general term, including all aspects of motion -- acceleration, particle velocity, displacement, stress, and strain.

ground velocity - Velocity obtained by the ground during one earthquake as a function of acceleration times duration.

grout - Mortar containing a considerable amount of water so that it has the consistency of a viscous liquid, permitting it to be poured or pumped into joints, spaces, and cracks within masonry walls and floors, between pieces of ceramic clay, slate, and floor tile, and into the joints between preformed roof deck units. In foundation work, mixtures of cement, cement-sand, clay or chemicals; used to fill voids in granular soils, usually by process of successive injection through drilled holes (Harris).

grouting - Pumping of a liquid, such as cement or epoxy, under pressure into the voids or cavities in a wall or other element; seismic anchor bolts are frequently grouted in place (Harris).

GSAP - Getty Seismic Adobe Project.

gunite - Pneumatically applied concrete applied by a patented process. The dry sand-portland cement mix is transported by air through a hose to the nozzle. Water is added at the nozzle by a qualified nozzle operator. A small amount of material rebounds from the impact of the material and must be removed from the work continuously by another operator with a separate source of high pressure air. Gunite is different from **shotcrete** where water is introduced during mixing of the concrete in the hopper (Kariotis and Krakower).

gusset, gusset plate - A plate, usually triangular in shape, used to connect two or more members, or to add strength to a framework (Harris).

gutting - Act or process of indiscriminate demolition of the interior of a building; not a recommended treatment for a historic structure because of the loss of integrity, historic fabric and character, and physical evidence for future preservation work; recommend thorough documentation (drawings, photographs, and written description) and careful disassembly (if necessary) and labeling of parts for storage and re-assembly.

Hague Convention Symbols - Universally accepted symbols for level of damage to buildings. Following an earthquake, quick inspection of the damage is essential. Dangerous elements must be made safe. Historic buildings should have already been marked with the Hague Convention symbol ^. A system of

documentation was developed for use in rescue operations following the Montenegro earthquake. Internationally recognized color codes were superimposed on large-scale maps to show categories of damage. This system is provided below (Feilden):

- Usable. Green.
  - Grade 1. Slight superficial damage, virtually intact
  - Grade 2. Superficial damage, non structural
  - Grade 3. Superficial, light structural damage
- Temporarily unusable: Yellow.
  - Grade 1. Structural damage, eg., roofs and ceilings
  - Grade 2. Serious structural damage to walls etc.
- Unusable: Red.
  - Grade 1. Severe structural damage, unsafe but capable of repair.
  - Grade 2. Partial collapse, eg. roofs, floors etc.
  - Grade 3. Total collapse, requiring reconstruction of walls, etc.

HABS - Historic American Building Survey

HAER - Historic American Engineer Record

hard - Not easily dented, pierced, or crushed; resistant to pressure; firm and unyielding to the touch; rigid; solid and compact; opposed to being soft (Harris). Property of substances are determined by their ability to abrade or indent one another. For metals it is the diameter of the indentation made by a hardened steel sphere or the height of rebound of a small drop hammer that measures hardness (Krakower).

hardness - Resistance to deformation; quality of being **hard** (Cliver). A behavior characteristic of a material including resistance to indentation, resistance to abrasion, and dynamic rebound of an impacting body. Hardness can only be quantified when a specific test or method of measurement is given (Atkinson).

harmonic motion, damped - Wave phases out with distance.

harmonic motion, simple - Oscillatory motion of a wave, single frequencey.

hazard - The annual probability of occurrence that an event of given intensity will occur in a particular place (Feilden).

header - A masonry unit, laid so that its ends are exposed, overlapping two or more adjacent wythes of masonry and tying them together; a wooden framing member which crosses and supports the ends of joists, rafters, studs, etc., transferring the weight of the latter to parallel joists, rafters, studs, etc. (Harris).

header - Adobe bricks placed with the long direction perpendicular to the plane of the wall (GSAP).

header course - In masonry, a course consisting entirely of **headers** (Harris).

header face - Small end of the brick (Harris).

heritage value - Architectural, cultural, and/or historical value subscribed to a building or site. Heritage value may have varying definitions and importance from culture to culture (ISCARSAH).

higher modes of vibration - Greater number of waves in a vibration system.

historic district - A geographically definable area with a significant concentration of buildings, structures, sites, spaces or objects unified by past events, physical development, design, setting, materials, workmanship, sense of cohesiveness or related historical and aesthetic associations. The significance of a district may be recognized through listing in a local, state, or national register and may be protected legally through enactment of a local historic district ordinance administered by a historic district board or commission.

historic fabric - The original, or prime era physical construction materials of a building, structure, or city and of any later changes that have acquired significance through time.

historic structure - Any structure at least 50 years old that is listed in or potentially eligible for the National Register of Historic Places and/or a State or local register as an individual structure or as a contributing structure in a district. Structures less than 50 years old may also be historic if they posses exception significance, such as Dulles International Airport Terminal and Cape Kennedy.

historic structure report (HSR) - Each Historic Structure Report must include three elements.

1. The first element is an administrative date section, prepared by or with the owner or manager, that contains:
    a. The name, number, management category, and proposed treatment of the structure;
    b. The proposed use of the structure;
    c. Identification of the planning document proposing the treatment and use, and any other documents bearing on the proposed management, furnishings, and use of the structure;
    d. A justification of the proposed treatment (stabilization, preservation, restoration, rehabilitation, or reconstruction) in terms of the application of the *Secretary of the Interior's Standards for the Treatment of Historic Preservation Projects* and the characteristics and limitations of the resource;
    e. Any recommended change in the proposed treatment or use based on the degree of documentary or physical evidence, the condition of the historic structure, or other professional findings in the completed analysis section; and
    f. Recommendations for the documentation, cataloging, conservation, and storage of any objects, documents, records, photographs, negatives, and tapes collected or produced as a result of the study.
2. The second element is a physical history and analysis section, prepared by appropriate cultural resources specialists, usually an historian and an historical architect and/or engineer, that contains:
    a. A statement of the anthropological/archeological/historical, or architectural/engineering significance of the structure and its setting (including associated above-ground and subsurface features and their relationship to national, regional, or local history);
    b. A narrative and graphic description of the appearance, occupation, and use of the structure and its setting during significant periods or lover time, based on a documentary and oral historical evidence, physical evidence from architectural fabric investigation, and any archeological investigation; all sources of information and data must be cited;
    c. A description and record of existing conditions, using measured drawings and photography prepared to HABS/HAER standards;
    d. An evaluation of the impact of the proposed use on the integrity of the structure, including the effect of compliance with regulations for human safety, energy conservation, handicapped access, etc;
    e. An engineering report on safety and load-bearing limits of the structure as warranted by the proposed use or apparent conditions;
    f. An identification and analysis of significant material, structural, natural, environmental, and human factors affecting preservation of the structure and recommended measures to deal with them, including any constraints on proposed use;
    g. The recommended steps for preservation, rehabilitation, restoration, or reconstruction; a discussion of the basis

for such recommendations; and preliminary drawings and engineering designs;

h. An analysis of the impact of the proposed action on the structure and its contents (if any) in accordance of the Secretary's Standards and on other affected cultural resources and the historic scene, with recommendations to avoid or mitigate any potential adverse effects;

i. An updated package estimating detail providing cost estimates to carry out recommendations, prepared and reviewed by the appropriate specialists; and

g. A recommendation for further study in support of the proposed treatment project, if necessary, with suggested sources.

3. The third and last element is an appendix that contains:

a. A record of all fabric analyses performed (paint, mortar, etc.) listing basic data with specific recommendation for treatment;

b. An assessment of future anthropological/archeological, historic and/or architectural/engineering research potential;

c. Records of any documentary data such as furnishings evidence, found during the investigation that are pertinent to the structure or setting but not to the treatment project for which the report was funded; comprehensive collections of data should be undertaken under separately funded studies; and

d. An annotated bibliography of sources.

Data obtained during treatment and not previously included in the Historic Structure Report should be presented in an addendum to the report. Further addenda are appropriate whenever new data become available. During the course of research for a HSR, it may be economical or desirable to gather data not specifically needed to support the treatment project. Such data on a structure, it occupants, its grounds, and/or its furnishings may be desired for interpretation or other purposes. When such is the case, the owner or manager should program for a Historic Resources Study, Cultural Landscape Report, and/or Historic Furnishings Report in conjunction with the HSR.

historical approach - Evaluation based upon historical research and past experience (ISCARSAH). See **qualitative approach** and **quantitative approach**.

holistic - Emphasizing the importance of the whole and the interdependency of its parts (ISCARSAH).

hollow clay tile (HCT) - Hollow terra cotta tiles used to construct walls and partitions in a building or used as forms in a concrete flooring system (in varying thicknesses up to a foot or more); walls and partitions were laid up with mortar similar to concrete masonry units (concrete blocks); floors were usually constructed as flat arches between beams using temporary shoring until the mortar cured.

horizontal diaphragm - The continuous membrane of a floor or roof which may be built of lath and plaster, gypsum board, plywood, straight sheathing, diagonal sheathing, concrete and metal deck. Assemblies with these materials have been tested and assigned allowable capacities and allowable length to width ratios to resist equivalent lateral forces from winds or earthquakes (Krakower).

horizontal flexural cracking - Horizontal cracks formed in a building or wall as a result of a loading system having high magnitudes of bending or flexural loads compared to shear loads (Atkinson).

HSR - Historic structure report.

hypocenter - The pointy below the epicenter at which an earthquake actually begins the focus. An alternative word for focus (*Consulting Engineer,* May l978).

hypocentral distance - The distance from an observation station to the focus (*Consulting Engineer,* May l978).

I-beam - A rolled or extruded structural metal beam having a cross section resembling the letter I (Harris).

ICBO - International Conference of Building Officials, publishers of the *Uniform Building Code* and the *Uniform Code for Building Conservation*.

ICOMOS - International Council on Monuments and Sites.

ICCROM - International Centre for the Study of the Preservation and Restoration of Cultural Property, was established in Rome, Italy, in l961. The four statutory functions are: (1) clearinghouse of documentation for conservation professionals around the world; (2) research in the theory of conservation methods, examination and documentation of works of art and historic buildings, and methods of conservation; (3) assistance to member States through missions of experts who offer expertise, inspect restoration work on monuments, or supply technical assistance; and (4) training for architects, conservators, and museum professionals in Rome and programs in abroad. The U.S.A. is a member State.

impost - A masonry unit or course, often distinctively profiled, which receives and distributes the thrust at each end of an arch (Harris).

impost block, dosseret, supercapital - A transitional member, often tapered, placed above a column capital to receive the thrust of vaults or arches (Harris).

inelastic behavior - Behavior of a structure or member beyond the elastic limit of the material.

infill frame building (also infill masonry frame building) - A steel or concrete frame building with masonry infill exterior (could be interior also) walls as opposed to a bearing wall masonry building; the masonry panels between columns are supported at each floor level by spandrel beams.

in-plane - Deflections or forces that are in the plane of a wall (GSAP).

in-plane shear - Lateral forces in the plane of the element.

in-plane shear failure - Failure of an element in shear or diagonal tension due to lateral forces in the plane of the element (Cocke and Bonneville).

integrity is the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during its historic or prehistoric period; the extent to which a property retains its historic appearance [National Park Service].

intensity - A subjective measure of the force of an earthquake at a particular place as determined by its effects on persons, structures, and earth materials. Intensity is a measure of effects as contrasted with magnitude, which is a measure of energy. The principle scale used in the United States today is the Modified Mercalli, 1956 version [AIA].

intensity - Indicates the effects of the earthquake in a determined place and is measured by instrumental records.

intensity of use - The measure of actual time periods of an activity and the actual number of persons involved, for a particular proposed use of a qualified historic building as compared against the same measure of an existing or prior use. This may differ substantially from occupancy load measurements in various regular or adopted codes (SHBC).

intervention - The physical intrusion upon a building during a diagnosis, or its therapy (ISCARSAH).

intrados - The inner curve or face of an arch or vault forming the concave underside (Harris).

investigation - A systematic and detailed evaluation of a building that can include examination, material testing, structural analysis, and structural testing (ISCARSAH). See **diagnosis**, **examination**,

material testing, **structural analysis**, and **structural testing**.

ISCARSAH - International Scientific Committee for Analysis and Restoration of Structures of Architectural Heritage, a committee of ICOMOS

isoseismal - Isoseismal is an imaginary line connecting all points on the surface of the earth where an earthquake shock is the same intensity [AIA]. These are depicted on maps as isoseismal lines.

joint - The space between adjacent surfaces (as between masonry units), or the place where two members or components are held together by nails, fasteners, cement, mortar, etc. (Harris).

joist - One of a series of parallel beams of timber, reinforced concrete, or steel used to support floor and ceiling loads, and supported in turn by larger beams, girders, or bearing walls; the widest dimension is vertically oriented (Harris).

joists - Closely spaced horizontal beams (spaced at approximately 2 feet [0.6 meters] on center in the protype domain) that span an area, such as a floor or ceiling (GSAP).

K factor - It is a factor that describes the structural system for a building and is used to determine seismic loads (Fatehi).

kip - A unit of force equal to 1,000 pounds (lbs).

LABC - Los Angeles Building Code.

landmark - A general term meaning historic building or structure. A landmark may be of local, State, or national significance. See **National Historic Landmark**.

large scale [adobe model] - Half-size adobe model. 1:2 scale (GSAP).

lateral capacity - Ability of the building to resist equivalent horizontal forces of wind and seismic effects (Krakower).

lateral force - Wind and/or earthquake load.

lateral force coefficients - Lateral force coefficients are factors applied to the general equations for lateral force to account for specific conditions, such as type of structure, type of soil, height, etc. [AIA].

lateral load - Wind load and/or **earthquake load**.

latias - Wooden poles about 2 inches in diameter laid across the top of *vigas* (see ***viga***) in floor and roof construction of early adobe buildings (NPS). Handsplit planks (see ***cedros*** and ***savinos***) were used if available.

life safety - Particularly associated with a degree of freedom from hazards or **distinct hazards** that might cause loss of life (SHBC).

life-safety level of strengthening - A strengthening planned specifically for reduction of life-safety hazards. This is accomplished by strengthening parts of the building that have historically caused loss of life in earthquakes (Kariotis). A level of strengthening designed with the objective of preventing the following events from occurring during an earthquake: (1) the entire building collapse, (2) portions of the building collapse, (3) components of the building fail and fall, and (4) exit and entry routes are blocked, preventing the evacuation and rescue of the occupants (Cocke and Bonneville).

lime, anhydrous lime, burnt lime, calcium oxide, caustic lime, common lime, quicklime - A white or grayish white caustic substance; usually obtained by heating limestone or marble at a high temperature to drive off carbon dioxide, leaving a residue of calcium and, or, magnesium oxide; when water is added, a lime putty is formed, called **hydrated lime** or **slaked lime** (calcium and, or, magnesium oxide), which is used in mortars and cements (Cliver).

lime-and-cement mortar - Hydrated lime, lime

putty, or slaked lime mixed with portland and, or, natural cement and sand; forms a cement mortar used in masonry and in portland cement plaster (stucco). See **Traditional Mortar.**

lime mortar - Hydrated lime mixed with sand; forms a lime mortar used in traditional masonry and in lime plaster (stucco). See **traditional mortar**.

limit state (expected strength) capacities - A limit state capacity of a material or system is when a defined limit state is reached. This could be cracking of a brittle material, yielding of a steel member or a displacement. Since all materials do not have a precisely defined limit state due to variation in material properties, a limit state is defined by an "expected" or average value of a property (Kariotis).

link beam - Beam that link or connect together two shearwalls or a wall and a column (Fatehi).

lintel - A horizontal structural member (such as a beam) over an opening which carries the weight of the wall above it; usually of steel, stone, or wood (Harris).

lintel - A horizontal structural member that spans the opening over a window or a door in a wall and can carry the weight of the wall above the opening. In historic adobe buildings, lintels are usually made of wood (GSAP).

liquefaction - Liquefaction is the sudden transformation of a granular material (soil) from a solid state into a liquefied state as a consequence of increased pore-water pressure (during shaking or vibrations) [AIA]. The sudden, large decrease of shearing resistance of a cohesionless soil caused by a collapse of the soil structure, produced by shock or small shear strains, associated with a sudden but temporary increase of pore water pressures of earthquakes.

load - Force, or system of forces, carried by building, structural system, or building component or element, such as dead load, live load, wind load, snow load, and earthquake or seismic load.

load-bearing - Building elements, such as walls, that carry vertical loads from floors or roofs (GSAP).

load bearing partition - A partition capable of supporting a load in addition to its own weight.

load bearing wall - A wall capable of supporting an imposed load in addition to its own weight.

longitudinal wave - Pure compressional wave with volume changes [AIA].

Love wave - Transverse vibration of seismic surface wave [AIA].

lug - A small projection attached to any member or component for use in handling, assembling, or installing (Harris).

lug bolt - A round bolt to which is welded a flat iron bar (Harris).

lumped mass - For analysis purposes, group weight of any one floor of a building at the center of gravity of that elevation [AIA].

macrozones - Large zones of earthquake activity such as zones designated by the Uniform Building Code map [AIA].

magnification factor - An increase in lateral force coefficients at a specific site for a specific factor [AIA].

magniture - Magnitude is a measure of earthquake size, determined by taking the common logarithm (base 10) of the largest ground motion observed during the arrival of a P-wave or seismic surface wave and applying a standard correction for distance to the epicenter [AIA].

maintenance - Act or process of applying measures to ensure the upkeep of a building in a good state of repair and utility. It is not a single branch of learning

or a single trade capable of definition. It is a mongrel science of a varied ancestry: part architecture, part physical chemistry, part management, and more. Maintenance in historic building terms in consists of all those day by day activities necessary to prolong the life of an historic property. The maintenance craftsperson is an individual with the necessary skill to make minor repairs to and replacements of building elements; this skill also includes the knowledge of what not to do (Chambers). A properly maintained historic building seldom needs massive restoration, rehabilitation, or reconstruction. Deferred maintenance usually results in severe deterioration and costs, on an average, three times as much as routine maintenance because of the replacement of large quantities of materials. Buildings poorly maintained usually behave poorly during seismic events because they start to fail at the weakest point.

malleability - The ability to be mechanically deformed without rupture or an increase in resistance to deformation, see **ductility** (Cliver).

mansard roof, mansard - (USA and British) A roof having a double slope on one or more sides of the building, the lower slope being much steeper; (British) Same as **gambrel roof** (USA). (Harris).

mantle - Mantle is the main bulk of the earth between the crust and the core.

masonry - The art of shaping, arranging, and uniting adobe, stone, brick, terra cotta, concrete building blocks, etc., to form walls and other parts of a building (Harris).

material testing - Laboratory or field testing of materials (physical, chemical, porosity, accelerated weathering, etc. (ISCARSAH).

mean value - The median value of a number of values obtained by testing or similar methods. Generally synonymous with average value (Kariotis).

measured drawings - The traditional way to record a building is to hand measure and prepare measured drawings. When these drawings consist of floor plans, and window opening locations, they are only a good start. While plan information is important for recording of historic buildings, it does not go far enough. Buildings contain more than twice as much vertical surface, such as walls, than they do floors. Measured drawings often include interior and exterior elevations, sections, and axiometrics. Standards for quality and permanence of measured drawings are published by the **HABS/HAER**.

meizoseismal area - Pertaining to the maximum destructive force of an earthquake, i.e., meizoseismal area is to the area of strong shaking [AIA].

microregionalization - Breaking up of macrozones into smaller zones of specific earthquake intensity [AIA].

minimal intervention - Minimal intervention is the principle that usually the less change or alteration done to a cultural resource the more integrity the resource retains. If each generation makes major changes or alterations to a resource, sooner or later there is little or no resource left to preserve and pass on to future generations [David Look].

modal analysis - All the possible modes of vibrations of a structure; can be related to ground motion [AIA].

modal response - The motion of all the masses in a system at any instant can be expressed as the sum of the individual modes of vibrations. On a time basis, the motions of to each mode vary so that the total response is continually changing. Mathematical examination of structures involves the assessment of response of systems, mode by mode, and the motion of system in all modes is called a 'modal response' (Kariotis).

mode - A shape of oscillation which can be generated in a given system of members and masses. Generally there are as many modes as there are degrees of freedom of the masses in the system. In

any given mode the masses achieve the same proportion of their maximum displacement at the same time (*Consulting Engineer,* May l978).

model buildings - UAB Model - unretrofitted adobe model, 1:2 scale. Same as Model 1.
RAB Model - retrofitted adobe model, 1:2 scale. Same as Model 2.
Model 8 - retrofitted adobe model, 1:5 scale.
Model 9 - unretrofitted adobe model, 1:5 scale (GSAP).

model domain - Building properties expressed in scale model size dimensions (GSAP).

Modified Mercalli Scale - While magnitude characterizes the earthquake itself, intensity indicates the effects of the earthquake in a determined place. Intensity has been expressed in degrees (I to XII) on the Modified Mercalli Scale, which classifies the observable damage to buildings and installations caused by the shaking ground. Damage caused by an earthquake of a given magnitude and the intensity with which the earthquake is felt in a determined place, depends on many things: the distance from the epicenter, the main direction, frequency, content, type of the seismic waves, the local ground conditions, the condition of the buildings affected (i.e., whether they have been well maintained and the quality of workmanship on previous repairs), their form and design, etc. (Feilden).

modulus of elasticity - In an elastic material which has been subject to strain below its elastic limit, the ratio of the unit stress to the corresponding unit strain (Harris).

modulus of resilience - The amount of elastic energy absorbed by a unit volume of a material when it is loaded to its elastic limit in tension (Harris).

modulus of rigidity, modulus of shear - In an elastic material which has been subjected to stress, the ratio of the shearing stress to the shearing strain (Harris).

modulus of rupture - A measure of the ultimate load-carrying capacity of a beam; equal to the ratio of the bending moment at rupture to the section modulus of the beam (Harris).

moment - The property by which a force tends to cause a body, to which it is applied, to rotate about a point or line; equal in magnitude to the product of the force and the perpendicular distance of the point from the line of action of the force (Harris).

moment frame - Frame in which lateral forces are transmitted through stiff connections at joints.

moment-resisting frame - A steel frame designed to provide in-plane resistance to lateral loads through the fixity of the joint connections between the column and beam members, and bending in the members (Cocke and Bonneville).

mortar - A mortar is a mix of one or more binders, aggregates, and water. Sometimes additives in certain proportions are included to give the mixture appropriate consistency and workability in the fresh state and adequate physical-mechanical properties when hardened (ISCARSAH).

mortar, mortar mix - A plastic mixture of cementitious materials (such as plaster, cement, or lime) with water and a fine aggregate (such as sand); can be troweled in the plastic state; hardens in place. When used in masonry construction, the mixture may contain masonry cement or ordinary hydraulic cement with lime (and often other admixtures) to increase its plasticity and durability (Harris).

mortise - A hole, cavity, notch, slot, or recess cut into a timber or piece of other material; usually receives a **tenon**, but also has other purposes, as to receive a lock (Harris).

mud flow - Mass movement of material finer than sand, lubricated with large amounts of water [AIA].

multi leaf masonry - Masonry made of leaves of different constitution. The most common is the three

leaves masonry made of two external faces and an inner rubble core (ISCARSAH).

NAPC - National Alliance of Preservation Commissions

National Center for Preservation Technology and Training - The National Center for Preservation Technology and Training (NCPTT) promotes and enhances the preservation and conservation of prehistoric and historic resources in the United States for present and future generations through the advancement and dissemination of preservation technology and training.
NCPTT, created by Congress, is an interdisciplinary program of the National Park Service to advance the art, craft and science of historic preservation in the fields of archeology, historic architecture, historic landscapes, objects and materials conservation, and interpretation. NCPTT serves public and private practitioners through research, education and information management [NCPTT].

National Earthquake Hazards Reduction Program (NEHRP) - Federal program developed in response to the Earthquake Hazards Reduction Act of l977.

National Historic Landmark (NHL) - The NHL Program takes its roots from the Historic Sites Act of l935 which authorized the Secretary of the Interior to "make a survey of historic and archeological sites, buildings, and objects for the purpose of determining which possess exceptional value as commemorating or illustrating the history of the United States." NHLs are buildings, sites, districts, structures, and objects that have been determined by the Secretary of the Interior to be of exceptional national significance in American history and culture. Many of the most renowned historic properties in the Nation are Landmarks. Mount Vernon, the Alamo, Mission San Juan Bautista, the *Balclutha,* and the San Francisco Civic Center are Landmarks that illustrate important contributions to the Nation's historical development. There are just over 2,200 NHLs in the United States and its territories.

National Park Service - Founded in l916 and now celebrating its 75th anniversary (1991), the National Park Service (NPS) is the Federal agency assigned the principal responsibility for administering Federal historic preservation programs providing for the identification, documentation, registration, and preservation of the nation's cultural resources. Under Public Law 96-515, the NPS is directed to develop and make available to Federal agencies, State and local governments, private organizations pursuant to the World Heritage Convention, training in, and information concerning, professional methods and techniques for the preservation of historic and prehistoric properties and for the administration of the historic preservation programs at the Federal, State, and local level.

National Register of Historic Places - The official list of the Nation's cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of l966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register is administered by the National Park Service under the Secretary of the Interior. Properties listed in the National Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and cultures. These resources contribute to an understanding of the historic and cultural foundations of the Nation. Properties are nominated to the National Register by the **State Historic Preservation Officer (SHPO)**.

National Register Criteria for Evaluation - The National Register's standards for evaluating the significance of properties developed to recognize the accomplishments of all peoples who have made a contribution to our country's history and heritage. The criteria are designed to guide State and local governments, Federal agencies, and others in evaluating potential entries in the National Register. Criteria for Evaluation: The quality of significance in American history, architecture, archeology,

engineering and culture as represented in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and: (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or (d) that have yielded, or may be likely to yield, information important in prehistory or history.

natural frequency - A constant frequency of a vibrating system in the state of natural oscillations [AIA].

natural stone - Natural stones have been formed by geological processes. They consist of mixtures of minerals. Natural stone can be grouped according to their origin into magmatic, metamorphous, and sedimentary stones (sandstone, limestone, etc.). Natural stones differ by origin, if their composition has not been altered by man. They are cut and/or carved or regularly or irregularly preceding use or, in the case of boulders used in foundations, left as they were (ISCARSAH).

nave - The middle aisle of a church; by extension, both middle and side aisles of a church from the entrance to the crossing or chancel; that part of the church intended primarily for the laity (Harris). The central part of a church between the main entrance and the altar (Krakower).

NCEER - National Center for Earthquake Engineering Research

NCPTT - National Center for Preservation Technology and Training

NCSHPO - National Conference of State Historic Preservation Officers

needle beam - A crossbeam supporting a load; used in **underpinning** foundation walls, attached to columns at its ends, clear of the existing footing (Harris). Also used as temporary shoring to introduce openings in brick walls.

NEHRP - National Earthquake Hazards Reduction Program.

NHL - National Historic Landmark.

niche - A recess in a wall, usually to contain sculpture or an urn; often semicircular in plan, surmounted by a half dome (Harris).

nondestructive testing - Act or process of testing materials or systems generally in place without resulting in damage to the building (Krakower and Cliver).

non-load-bearing - Building elements, such as walls, that do not carry vertical loads from floors or roofs (GSAP).

nonstructural component - A building component which is not intended primarily for the structural support and bracing of the building [AIA].

normal fault - A fault under tension where the overlying block moves down the dip or slope of the fault plane.

normalization - A method of standardizing characteristics of vibrations [AIA].

NPI - National Preservation Institute

NPS - National Park Service.

NRHP - National Register of Historic Places

NTHP - National Trust for Historic Preservation

nuisance - Any building, site, or portion thereof containing numerous non life-threatening violations

of the building code (SHBC).

object conservation - Measures taken to prolong the life of a museum object. The primary goal of museum conservation is to preserve whatever still exists of an original object as nearly as possible in an unchanging, stabilized state (SHBC).

oblique-slip fault - A combination of normal and slip or thrust and slip faults whose movement is diagonal along the dip of the fault plane.

observational method - An increment approach to intervene or to strengthen, starting from a minimum lever of intervention, with possible subsequent adoption of a series of corrective measures (ISCARSAH).

OES - Governor's Office of Emergency Services

OHP - Office of Historic Preservation

out of phase - The state where a structure is not at the same frequency (mode of vibration) as the ground motion; or equipment in a building vibrating at a different frequency from the structure [AIA].

out-of-plane - Perpendicular or orthogonal to the plane (Fatehi).

out-of-plane - Deflections or forces that are perpendicular to the plane of a wall (GSAP).

out-of-plane wall failure - Failure of a wall element in bending out-of-plane due to the application of lateral forces (Cocke and Bonneville).

overburden - The entire thickness of soil over rock or over a specific bearing stratum; an undesirable top layer covering rock, gravel, or other useful material wanted for construction (Harris).

overturning - Collapse of a wall caused by rotation of the wall about its base (GSAP).

quantitative approach - Evaluation based on analytic or scientific methods such as testing, calculations, and mathematical modeling (ISCARSAH). See **historical approach** and **qualitative approach**.

P-wave - The primary or fastest waves travelling away from a seismic event through the solid rock and consisting of a train of compressions and dilations of the material [AIA].

parapet - A low guarding wall at any point of sudden drop, as at the edge of a terrace, roof, battlement, balcony, etc; in an exterior wall, fire wall, or party wall, the part entirely above the roof (Harris).

participation factor - At any given instant the contribution of a given mode to the total response can be assessed. The proportion of contribution of a single mode is called the participation factor of that mode (*Consulting Engineer,* May l978).

period (of a wave) - The time interval between the arrival of successive crests in a homogenous train. The predominant period is a number representing the time between seismic wave peaks to which a building on the ground is most vulnerable, usually measured in seconds [AIA].

period - The time for a wave crest to transverse a distance equal to one wave length or the time for two successive wave crests to pass a fixed point [AIA].The time taken for a system to move from the mean position and return but traveling in the same direction, i.e. in passing through the mean position twice. The fundamental period is that of the normal mode (*Consulting Engineer,* May l978). In uniform circular motion the time of one complete revolution. In any oscillatory motion it is the time of one complete oscillation (Krakower).

permeability - The rate of diffusion of a gas or vapor through a solid; differences in permeability or vapor transmission between mortar and masonry units may cause deterioration in a masonry wall (Cliver).

PGA - Peak ground acceleration is the maximum acceleration of the ground at a particular location during an earthquake

photogrammetry - Method of recording which is especially useful for buildings with inaccessible exterior elevations such as towers and steeples; even floor and ceiling plans can be recorded with this method. Photogrammetry uses stereo pairs, two separate photographs each taken at a precise distance apart, like the antique stereopticon. Recent methods and equipment allow the perspective of these photographs to be interpreted in two dimensional plan and elevation with the aid of a sophisticated plotting machine. The method is accurate and can readily detect and measure the misalignment in old structures. Although an expensive procedure, there are some conditions in which photogrammetry is the only tool for information retrieval (Chambers). See **Rectified Photography**. See *Photogrammetric Recording of Cultural Resources* in bibliography.

pilaster - An engaged pier or pillar, often with capital and base. Decorative features that imitate engaged piers but are not supporting structures, as a rectangular or semicircular member used as a simulated pillar in entrances and other door openings and fireplace mantels; often contains a base, shaft, and capital; may be constructed as a projection of the wall itself (Harris).

pile - A concrete, steel, or wood column, usually less than 2 feet (0.6 meter) in diameter, which is driven or otherwise introduced into the soil, usually to carry a vertical load or to provide lateral support. Capacity in the soil can be by skin friction, and bearing, or a combination of the two (Krakower).

plan - A two-dimensional graphic representation of the design, location, and dimensions of the project, or parts thereof, seen in a horizontal plane viewed from above (or below for ceilings).

plaster - A paste-like material, usually a mixture of portland cement, lime, or gypsum with water and sand; fiber or hair may be added as a binder (generally only with lime plaster); applied to surfaces such as walls or ceilings in the plastic state; later it sets to form a hard surface (Cliver).

plastic deformation, plastic flow - The deformation of a plastic material beyond the point of recovery, accompanied by continuing deformation with no further increase in stress; results in a permanent change in shape.

plastic design - Similar to inelastic design; the term is specifically applied to steel where stresses are beyond the yield limit [AIA].

plate - A thin, flat sheet of material; in wood frame construction, a horizontal board or timber connecting and terminating posts, joists, rafters, etc.; a timber laid horizontally (and on its widest side) in a wall or on top of a wall or on the ground to receive other timbers or joists; in plate tectonic theory, one of the 22 large sections of the earth's crust.

plate tectonics - The theory and study of plate formation, movement, interaction, and destruction; the attempt to explain seismicity, volcanism, mountain building, and paleomagnetic evidence in terms of plate motions [AIA].

plate tectonic theory - The surface of the earth consists of about twenty independent tectonic plates floating on a softer inner layer. These plates are in continuous motion relative to each other because of currents in the internal liquid core of the earth. Thus, elastic energy accumulates along the edges of the plates, and is eventually released with a sudden movement, which causes brief, strong vibrations in the ground: an earthquake (Feilden).

plated anchors - Part of the specified anchorage assembly that is visible, see **exposed washer plates** (Krakower).

platform frame, platform framing, western frame - A timber framework in which the studs are only one story high; the floor joists of each story rest on the top plates of the story below or on the foundation sill

for the first story, and the stud walls or bearing walls and partitions rest on the subfloor of each story, see **balloon frame** (Cliver).

pointing - In masonry, the final treatment of joints by the troweling of mortar or a putty-like filler into the joints. The material with which the joints are filled. The removal of mortar from between the joints of masonry units and the replacing of it with new mortar; **repointing**.

polyester resin anchors - A bolt or rod described with concealed anchors embedded in a polyester resin material (Krakower).

portico - A porch or covered walk consisting of a roof supported by columns; a colonnaded (continuous row of columns) porch (Harris).

post - Any stiff, vertical, more or less isolated upright; may be of wood, stone, metal, etc.; may support a superstructure or afford a firm point of lateral attachment (Harris).

post-and-beam construction - Generally of timber, see **post-and-lintel construction**.

post-and-beam framing - A type of framing in which horizontal members rest on a post as distinguished from a wall (Harris).

post-and-lintel construction - A type of construction characterized by the use of vertical columns (posts) and horizontal beam (lintel) to carry a load over an opening-in contrast to systems employing arches or vaults (Harris).

pounding - The lateral collisions of adjacent buildings during earthquakes that occurs when building separations are insufficient to accommodate the relative movement of adjacent buildings (Cocke and Bonneville).

preservation - Act or process of applying measures to sustain the existing form, integrity, and material of a building or structure, and the existing form and vegetative cover of a site. It may include initial stabilization work, where necessary, as well as ongoing maintenance of the historic building materials (Secretary).

preservation maintenance, preventive maintenance - The act or process of applying preservation treatments to a cultural resource. It includes housekeeping and routine and cyclic work scheduled to mitigate wear and deterioration without altering the appearance of the resource; repair or replacement in kind of broken or worn-out elements, parts, or surfaces so as to keep the existing appearance of the site; stabilization work necessary to protect damaged historic fabric from additional damage; and actions taken to prevent damage and to minimize deterioration of museum object by practicing preventive conservation or by performing a suitable treatment on an object itself (SHBC).

preventive conservation - That part of the preservation function of object conservation that attempts to prevent harm to an object before its occurs. This function includes actions that monitor and control the museum environment, improve storage and exhibit methods, ensure periodic inspections of objects, ensure proper housekeeping procedures, maintain proper housekeeping procedures, maintain appropriate security measures, prevent damage from improper handling and transporting of objects, etc. (SHBC)

prime historical period - The historical period in the life of a qualified historical building or structure that has been determined to be the most architecturally and/or historically significant (SHBC).

protection - Act or process of applying measures designed to affect the physical condition of a property by defending or guarding it from deterioration, loss or attack, or to cover or shield the property from danger or injury. In the case of buildings and structures, such treatment is generally of a temporary nature and anticipates future historic preservation treatment; in the case of archeological sites, the protective measure may be temporary or

permanent (Secretary).

prototype domain - Building properties expressed in full-scale size dimensions (GSAP).

psi - Pounds per square inch.

push test - An inplace shear test made on unreinforced masonry. This test is described in UBC Standard 24-40 (Kariotis).

rafter - One of a series of inclined members to which a roof covering is fixed. See also **common rafter** (Harris).

rafters - Parallel, sloping timbers or beams that give form and support to a roof (GSAP).

rafter plate - A plate, which supports the lower end of rafters and to which they are fixed (Harris).

Raleigh wave - Forward and vertical vibration of seismic surface waves [AIA].

rammed earth - A material usually consisting of clay, sand, or other aggregate (such as sea shells) and water, which has been compressed (pounded) and sun dried; used in building construction around the world in arid climates; construction methods are similar to poured-in-place concrete with wooden forms to confine the wet mud until it dries.

rebound hardness test - A test to measure the hardness of a material as a function of the rebound of a standardized impact object (Atkinson).

reconstruction - Act or process of reproducing by new construction the exact form and detail of a vanished building, structure, or object, or a part thereof, as it appeared at a specific period of time (Secretary).

rectified photography - Method which provides photographic negatives of predetermined size or scale which can be printed on photo sensitive drafting film for use as working drawings, surveys, feasibility studies, etc. Rectified Photography, carefully done, can eliminate much of the time consumed in the measuring of complicated vertical surfaces. It is also possible to record ceilings using this method. The end result is a photograph of one plane (one wall or surface) which can be scaled like an architect's drawing. Anything in front of or behind this plane would not be to scale (Chambers). See *Rectified Photography and Photo Drawings for Historic Preservation* in bibliography.

redundancy - Redundancy refers to the availability of alternative paths for resolution of earthquake-induces forces in a structure. When there is only one path, the loss of that path can have catastrophic impacts on the structure. When there are several, then the loss of one need not have major consequences. Earthquake engineering is not a precise science, and our ability to predict performance is still limited. As a matter of course, all designers want to provide several paths for force transfer because the state-of-the-art does not allow assurance that if only one is provided the structure will perform as expected. The greater the redundancy, the more confidence there is in satisfactory seismic response (GSAP).

registered historic district - Any district that is listed in the National Register of Historic Places, or designated under a State or local statue which has been certified by the National Park Service as meeting criteria which will substantially achieve the purpose of preserving and rehabilitating buildings of significance to the district and which is certified as substantially meeting all of the requirements for listing of districts in the National Register.

rehabilitation - Act or process of returning a property to a state of utility through repair or alteration which makes possible an efficient contemporary use while preserving those portions or features of the property which are significant to its historical, architectural, and cultural values (Secretary).

relocation - Involves any structure or a portion of a

structure that may be moved to a new location (SHBC). Relocation is not a recommended treatment except as a last resort.

remodel - To model again; to make over; rebuild.

remodeling - Act or process of changing a building from its existing condition to anything the owner wants, often without regard for its integrity; not a recommended treatment for a historic building.

rendering - Applying a coat of plaster directly on an interior wall or stucco on an exterior wall; a perspective or elevation drawing of a project or portion thereof with artistic delineation of materials, shades, and shadows (Harris).

renovation - Act or process of making new or like new; modernization that may produce inappropriate alterations or elimination of important features and details; not a recommended treatment for historic buildings, see **remodeling**.

repair - Act or process of putting back in good condition after damage, decay, or deterioration by mending or fixing with like materials that are compatible in visual, physical, and functional characteristics.

replace - Act or process of placing again; putting back in a former position and condition; providing a substitute or equivalent for a lost, damaged, or deteriorated material.

replica - See **facsimile**.

replication - Act or process of making a copy, or an exact copy of a historic building on a new site or a faithful reproduction so far as historical records of the building would allow on the same or a new site. Also, the construction of an exact copy on a site removed from the still extant building. Some buildings that may be involved in replication may be found on a historic building register even though they are not existing. Building elements can also be replicated when missing or in such poor condition they cannot be used. (Explanatory note: All portions of a structure that are either original or a replication may be involved in the construction process utilizing this code with the considered discretion of the enforcing official (SHBC). See **reconstruction**.

repointing - The replacement or repair of existing pointing, see **pointing** (Cliver).

repointing - Result of repair or restoration on a deteriorated joint. It can be homogeneous to the existing joint or made of different material (e.g. cement of polymer) (ISCARSAH).

reproduction - A duplication, copy, or close imitation of the original (SHBC).

research - Research is investigation aimed at the discovery and interpretation of facts, the revision of accepted theories in light of new facts, or the development of practical applications of such new revised theories [National Park Service].

resonance - Induced oscillations of maximum amplitude produced in a physical spectrum when an applied oscillatory stress and the natural oscillatory frequency of the system are the same [AIA].

response (of structure) - Mode of vibration of the building due to a give ground motion [AIA].

response spectrum - A family of curves of spectra in response to a given ground disturbance. A large number of response spectra may be combined to give a design spectrum (*Consulting Engineer,* May l978).

restoration - Act or process of accurately recovering the form and details of a property and its setting as it appeared at a particular period of time by means of the removal of later work or by replacement of missing earlier work (Secretary).

return period of earthquakes - The time period (years0 in which the probability is 63 percent that an earthquake of a certain magnitude will recur [AIA].

Revenue Act of l978 - Provided a 10% investment tax credit for the **certified rehabilitation** of a **certified historic structure**; supplanted by the **Economic Recovery Act of l981**.

reversibility - Reversibility is the principle that nothing should be done to a cultural resource that cannot be reversed or undone without permanent damage to the resource. In the future there may be better treatments. If irreversible treatments are undertaken, the cultural resource may have permanent damage and may be prevented from better treatments developed in the future [David Look].

reversibility - A preservation principle that requires that any treatment or addition to a historic structure must be removable without any damage to the historic fabric of the resource.

Richter magnitude scale - A measure of earthquake size, which describes the amount of energy released. The measure is determined by taking the common logarithm (base 10) of the largest ground motion observed during the arrival of a P-wave or seismic surface wave and applying a standard correction for distance to the epicenter [AIA].

Richter Scale - The magnitude of an earthquake is expressed in degree on the Richter scale. It indicates the absolute energy release of the earthquake and is calculated on the basis of recordings of the earthquake by accelerometers or seismographs in different locations (Feilden).

ridge - The horizontal line at the junction of the upper edges of two sloping roof surfaces; the internal angle or nook of a vault (Harris).

ridgeboard (same as the archaic terms, such as, ridge pole, ridge piece, ridge plate) - A longitudinal member at the apex of a roof which supports the upper ends of the rafters (Harris and Cliver).

rift (see graben) **-** A fault trough formed in a divergence zone or other area of tension [AIA].

rigidity - Overall stiffness of a structure to withstand deformation [AIA].

risk - The probable loss, combining the hazards of location and the vulnerability of buildings and their contents. Risk can be removed, transferred, shared, accepted, or accommodated (Feilden).

rose window, Catherine-wheel window, marigold window, wheel window -A large, circular medieval window, containing tracery (usually of stone) disposed in a radial manner; (USA) any round stained glass window in a church or cathedral (Harris and Cliver).

rotunda - A building round both inside and outside, usually domed; a circular hall in a large building, especially one covered by a cupola (Harris).

S-wave - Shear wave, produced essentially by the shearing or tearing motions of earthquakes at right angles to the direction of wave propagation [AIA].

SAA - Society for American Archaeology

SAA - Society of American Archivists

SAH - Society of Architectural Historians

SAH - Society for Historical Archaeology

SBA - U.S. Small Business Administration

sacristy - A room in a church, near the chancel, where the robes and altar vessels are stored, where the clergy vest themselves for services, and where some business of the church may be done; usually a single room, but sometimes a very large one (Harris). A room in a church where vestments and sacred articles are kept usually near the altar (Krakower).

Safety evaluation (assessment) - Evaluation of the safety margins of a structure regarding heavy damage, partial or total collapse. The opposite of

safety is risk (ISCARSAH). See **historical approach**, **qualitative approach**, and **quantitative approach**.

safety hazard - A hazard that can cause injury or be life threatening from causes other than fire or structural failure as in exposed sharp metal, broken glass, electrical shock, or gas asphyxiation (SHBC).

sag pond - A pond occupying a depression along a fault. The depression is due to uneven settling of the ground or other causes [AIA].

savinos - Handsplit cypress planks used in the construction of floors and roofs in adobe buildings, if available. See also ***cedros*** (NPS).

scagliola - An ornamental plasterwork of gypsum and glue, made in imitation of granite or marble. An imitation marble made by adding coloring agents and marble chips to a cement matrix, Portland or Keane's cement (Cliver).

scarp - A cliff, escarpment, or steep slope of some extent formed by a fault or a cliff or steep slope along the margin of a plateau, mesa or terrace [AIA].

Schmidt Hammer measurement - A measurement of material hardness obtained using the Schmidt Concrete Rebound Hammer. ASTM and International Society for Rock Mechanics standard test methods exist for use of the Schmidt Hammer on concrete and rock respectively (Atkinson).

scored stucco, scored plaster - Stucco or plaster with channels or grooves to imitate mortar joints and therefore give the appearance of masonry (Harris).

SEAOC - Structural Engineers Association of California

Secretary of the Interior's Standards for Historic Preservation Projects - Ten basic principles initially developed by the Secretary of the Interior to determine the appropriateness of proposed project work on registered historic properties. There are separate standards for each type of treatment: acquisition, **protection, stabilization, preservation, rehabilitation, restoration,** and **reconstruction**. Contains guidelines on how to apply the standards to historic buildings listing recommended and not recommended treatments.

Secretary of the Interior's Standards for Rehabilitation - Codified in 36 CFR 67, comprises that section of the overall preservation project standards and address the most prevalent treatment of **rehabilitation**. Contains guidelines on how to apply the standards to historic buildings listing recommended and not recommended treatments. The Standards for Rehabilitation have been widely used over the years - particularly to determine if a rehabilitation qualifies as a **Certified Rehabilitation** for Federal Tax purposes.

section - A two-dimensional representation of an object as it would appear if cut by an imaginary plane, showing the internal structure; a representation of a building, or portion thereof, drawn as if it were cut vertically to show the interior; such a representation of a molding or assembly of pieces, to show the profile or makeup; in structures, a section made by a plane perpendicular to the axis of a member, structure, or any construction; a subdivision of a division of the specifications, which covers the work of no more than one trade (Harris).

seiche - Wave oscillation of the surface of water in an enclosed or semi-enclosed basin (lake, bay or harbor) [AIA].

seiches - A disturbance within a closed body of water (*Consulting Engineer,* May l978).

seismic - Of or having to do with an earthquake or earthquakes, caused by an earthquake, or subject to earthquakes; pertaining to shock waves within the earth produced by earthquakes, or in some cases artificially produced shock waves [AIA].

seismic retrofit - All measures that improve the seismic performance, especially, those that affect

structural stability and reduce the potential for heavy structural damage or collapse (Tolles et al).

seismic strengthening - All measures that affect the strength of the materials, connections and overall configuration (such as the addition of shear walls or a diaphragm) and, therefore, the elastic behavior of the building (Tolles et al). Much of strengthening concepts is based on inelastic behavior (Krakower).

seismic surface wave - A seismic wave that follows the earth's surface only, with a speed less than that of S-waves [AIA].

seismicity - The world-wide or local distribution of earthquakes in space and time; a general term for the number of earthquakes in a unit of time [AIA].

seismograph - A seismological instrument of great sensitivity designed to determine the timing and nature of ground motion at points on the earth remote from the station. It is not capable of measuring actual site ground motion (*Consulting Engineer,* May l978). An instrument for magnifying and recording the motions of the earth's surface that are caused by seismic waves [AIA].

seismometer - A device designed to measure the effect of a ground disturbance on a particular structural system of given period and damping (*Consulting Engineer,* May l978).

seismiscope - The instrument which produces a seismograph; generally records small motions in contrast to strong motion instruments [AIA].

sense of place - The sum of attributes of any place that give it a unique and distinctive character.

shape memory alloy - Shape memory alloy, which usually has the form of wires, is a material that recover its original shape after that has suffered large deformations. It has also the characteristic of having hysteresis cycles remaining always in tension, allowing to the dissipation of energy. The force transmitted by the device, which uses shape memory alloy wires, remains below a pre-established value (or increases very slowly) for a large range of displacement. After a pre-established limit displacement the force transmitted increases again very quickly [Giorgio Croci].

shear - A deformation (e.g., in a beam, wall, or flexural (deep) member) in which parallel planes slide relative to each other so as to remain parallel (Harris).

shear distribution - Lateral forces along the height of a building [AIA].

shear failure, failure by rupture - Failure in which movement caused by shearing stresses (Krakower).

shear forces - Typically, shear forces in adobe walls are those that occur in the plan of the wall and cause diagonal cracking. Shear forces can also be developed out-of-plane in a wall and are caused by forces that produce an opposite, but parallel, sliding motion across an interface in the wall (GSAP).

shear modulus - See **modulus of rigidity**.

shear modulus "G" - See modulus of shear.

shear strength - The maximum **shear stress** which a material or soil is capable of sustaining (Harris). The stress or load at which a material fails in shear [AIA].

shear stress, shearing stress - The force per unit of area of cross section which tends to produce **shear** (Harris)..

shear wall - A wall which in its own plane carries **shear**, resulting from forces such as wind, blast, or earthquake (Harris). A vertical wall designed to transmit lateral forces in upper floors to the base of the structure [AIA].

sheathing - The covering (usually wood boards, or plywood) placed over exterior studding or rafters of a building; provides a base for the application of wall or roof cladding (Harris).

shore - A structural member, sometimes set in a diagonal or oblique angle, used to hold or support a another element until the element has sufficient strength or connection to other elements to be stable by itself (Krakower and Cliver).

shoring - A number of **shores** acting collectively. Can be used to support earthquake damaged buildings until they can be repaired and retrofitted (Krakower).

short column - A column whose load capacity need not be reduced because of its slenderness, see **slenderness ratio**.

shotcrete - A pneumatically applied concrete which is pumped through a hose and projected at high velocity onto a surface. Unlike **gunite**, the water is introduced during the initial mixing process. See **gunite** (Krakower).

SHPO - State Historic Preservation Officer.

sill - A horizontal timber, at the bottom of the frame of a wooden structure, which rests on the foundation; the horizontal bottom member of a window or door frame (Harris).

sill plate - Same as sill resting upon the foundation (Harris).

simulation - A counterfeit, imitation, or feigned resemblance of an original (SHBC). Substitute materials simulate the original object, building, or portion thereof.

slenderness ratio - Height to thickness ratio of a wall or column.

slenderness ratio (S_L) - The ration of the height of a wall to the thickness. In this document [*Getty Seismic Adobe Project*], the slenderness ratio of thick [adobe] walls is taken as S_L<6; for moderate walls, S_L = 6-8; and for thin walls, S_L>8 (GSAP).

slumping (of adobe) - When adobe becomes wet, it can become the consistency of peanut butter and flow under the load of the roof and/or its own weight.

slumping - Bulging at the base of an adobe wall. Can be caused by the loss of adobe strength due to an increase in the plasticity of adobe that results from moisture intrusion (GSAP).

soft story - As defined in the UBC, a soft story is one in which the lateral stiffness is less than 70 percent of that in the story above or less than 80 percent of the three stories above (Cocke and Bonneville).

soil-structure interation - Response of the structure to a specific soil motion [AIA].

solepiece - A horizontal member used to distribute the thrust of one or more uprights, posts, or struts (Harris).

soleplate - Same as **solepiece**; a horizontal timber which serves as a base for the studs in a stud partition; a plate riveted to the bottom flange of a plate girder to support the masonry plate (Harris).

small scale - One-fifth size adobe model. 1:5 scale (GSAP).

spandrel - In a multistory building, a wall panel filling the space between the top of the window in one story and the sill of the window in the story above (Harris).

spandrel beam - In concrete or steel construction, an exterior beam extending from column to column usually carrying an exterior wall load (Harris).

specified anchorage assembly - The combination of bolts, straps, nuts, plates, screws and washers interconnected to form as assembly with a computed capacity and spaced at regular intervals to tie a building together during an earthquake (Krakower).

spectra - A plot of acceleration, velocity and

displacement for various frequencies for a particular structure, for a single degree of freedom [AIA].

spectrum - In seismic terms a spectrum is a relationship between the responses of systems given in the form of acceleration, velocity, and displacement versus the period for various values of damping (Kariotis).

stable - Not easily moved or thrown off balance; not likely to break down, fall apart, or give way; firm; steady; fixed. Capable of returning to equilibrium or original position after having been displaced.

stability - Ability of a member or structure to resist applied forces without failure [AIA]. The resistance of a structure or element thereof to withstanding sliding, overturning, buckling, or collapsing.

stabilization - Act or process of applying measures designed to reestablish a weather resistant enclosure and the structural stability of an unsafe or deteriorated property while maintaining the essential form as it exists at present (Secretary).

stabilized adobe - A modern adobe brick containing cement, asphalt, and/or bituminous materials; these differ from traditional adobe in their appearance and strength.

standard deviation - A statistical term that describes the variance of extreme values from the mean value (Kariotis).

SHBC - State Historical Building Code.

SPNHC - Society for the Preservation of Natural History Collections

SSA - Seismological Society of America

State Historical Building Code (SHBC) - Mandatory code for all historic buildings in the State of California; it is permissive and allows alternate solutions rather than being prescriptive.

State Historic Preservation Officer (SHPO) - Usually appointed by the Governor, the SHPO is the principle State official who administers all of the Federal and State preservation programs at the State level and is the main contact point for these programs and for information and technical assistance.

static analysis - The analysis of a structural system as a function of forces acting on elements in equilibrium, as opposed to moving (Harris).

static design - Design based on static analysis.

statics - That branch of the science of mechanics concerned with forces acting on bodies in equilibrium.

stiff - Hard to bend or stretch; rigid; firm; not flexible or pliant.

stiffness - The ratio of the force applied to a structure (or a structural element) to the corresponding displacement. Proportioning of structural members to achieve a specific deformation [AIA].

stiffness factor - Of a member, the ratio of the moment of inertia of the cross section to its length.

stirrup - A bent rod, usually U-shaped or W-shaped; used in reinforced brick or concrete construction; a reinforcing device to resist shear and diagonal tension stresses in a beam; a hanger or metal seat, attached to a wall beam or post or hung from a girder, to receive and support a beam or joist (Harris).

stone - Rock selected (natural without processing) or processed by shaping, cutting, or sizing for building or other use (Harris).

story drift - The calculated or measured displacement of a story level relative to an adjacent story level (Kariotis).

straight sheathing - Commonly one or two inch thick continuous boards laid perpendicular to the

supports. Fastening same as for diagonal sheathing. Used for roofs and floors (Krakower).

strain - A change in the form or shape of a body or material which is subjected to an external force (stress) (Harris).

strain release - Movement along a fault plane; can be gradual or abrupt [AIA].

straps - Flexible cords, cables, or flat woven ribbons that encircle the walls and are used to minimize relative displacements and keep cracked adobe blocks in the plane of the wall during seismic shaking. May be made of nylon, polypropylene, or other strong, stable polymer. Steel Cables may also be used (GSAP).

stress - The internal forces set up at a point in an elastic material by action of external forces; expressed in units of force per unit area, e.g., pounds per square inch (psi) or kilograms per square millimeter (Harris).

stress-strain diagram - A diagram in which corresponding values of stress are plotted against strain; values of stress usually are plotted as ordinates (vertically) and values of strain as abscissas (horizontally) (Harris).

strength-based analytical design - This design procedure uses analytical techniques in which the resistance of the structure is based upon the elastic strength of the material. When using a strength-based approach, the design forces are always substantially less (by a factor of 5 to 10) than the forces that may be expected in the larger seismic events at a specific site. The assumption of this approach is that ductility of materials and connections will be sufficient to withstand the demand of these larger seismic events (Tolles et al).

stretcher - A masonry unit laid horizontally with its length in the direction of the face of the wall (Harris).

stretchers - Adobe blocks placed with their long direction parallel to the plane of the wall (GSAP).

stretcher bond, running bond, stretching bond - In masonry, a bond in which bricks or stones are laid lengthwise; all courses are laid as **stretchers** with the vertical joints of one course falling midway between those of adjacent courses (Harris).

stretcher course - A course consisting only of **stretchers** (Harris).

stretcher face - The long face of an exposed brick which is laid as a **stretcher** (Harris).

strike-slip fault (or lateral slip) - A fault whose relative displacement is purely horizontal.

stringcourse, belt course, soldier course - A horizontal band of masonry, sometimes narrower than other courses, extending across the facade of a structure and in some instances encircling such decorative features as pillars or engaged columns; generally projecting but may be flush, and can be flat-surfaced, molded, or richly carved; a bond course (Harris and Cliver).

strong motion accelerograph - A device designed to measure the absolute acceleration/time relationship of the ground on which the device is founded. The various properties of the device are a compromise to obtain, as faithfully as possible, the ground motion.

structural analysis - Calculations, computations, computer analysis, and mathematical models (ISCARSAH).

structural continuity - Structural continuity is provided by elements that can transfer dynamic forces between structural elements in either the vertical or horizontal direction. Structural continuity in adobe, as well as conventional, structures is extremely important for improving their dynamic performance. In thick-walled adobe buildings, the principal need is for elements that provide horizontal continuity among elements, including the blocks likely to be formed as cracking progresses as a result

of large ground motions. Gravity forces are the principal means by which forces are transferred in the vertical direction. The substantial mass of adobe walls makes provision of additional continuity in the vertical direction secondary. The continuous transfer of loads between parallel walls does much to increase the stability of both walls. Continuous elements in the plane of a wall improve the behavior of that wall by restricting the relative displacement of adjacent cracked adobe blocks. Flexible ties can keep the structure together and functioning as a system if they provide continuity across joints where cracks are expected to develop or already exist (GSAP).

structural scheme - An approximate representation (or model) of the structure, different, but close to the reality (ISCARSAH).

structural testing - Laboratory or field testing of structures (assembly and component testing, floor loading, shaking-tables, etc.). (ISCARSAH).

structural typology - The types of structures interpreted as regards their structural behavior and their capacity to bear loads (ISCARSAH).

structure - Any construction capable of carrying loads and usually for non-human occupation or habitation, such as a bridge or dam.

structure - The part of a building that provides the bearing capacity, sometimes coincident with the building itself (ISCARSAH).

strut - A brace or any piece of a frame which resists thrusts in the direction of its own length; may be upright, diagonal, or horizontal.

stucco - An exterior finish, usually textured; composed of lime and sand, and sometimes portland or natural cement, which are mixed with water when applied. Can also be a fine plaster used for decorative work or moldings (Cliver).

stud - An upright post or support, especially one of a series of vertical structural members which act as the supporting elements in a wall or partition (generally studs in post-and-beam construction are not structural); a cylindrical rod of moderate length, threaded on one or both ends or throughout its entire length (Harris and Cliver).

subduction - The sinking of a plate under an overriding plate in a convergence zone [AIA].

substandard building - A building that does not comply with the minimum conditions of the code may be considered substandard.

substantial rehabilitation - A **certified historic structure** must be substantially rehabilitated with the qualified expenditures exceeding the greater of $5,000 or the adjusted basis of the building. The adjusted basis is generally the actual cost of the property minus the cost of the land, plus any capital improvements already made, minus any depreciation already taken. The expenditure test to qualify for the tax credit must be met within a 24-month period or a 60-month period for phased projects if written architectural plans and specifications are completed before the rehabilitation begins.

tapanco - An attic, loft, garret, or half-story of a building that is accessed by stairs or a ladder in the gable end wall (GSAP).

Tax Reform Act of l976 - First of a series of acts that provided tax benefits for the rehabilitation of historic buildings; act provided the owners of a **certified rehabilitation** of a **certified historic building** to amortize the costs of the rehabilitation over a five-year period or to depreciate the costs of a substantially rehabilitated structure at an accelerated rate; supplanted by the Economic Recovery Act of l981.

Tax Reform Act of l986 - Act reduced the benefits of the Economic Recovery Act of l981 and restricted the use of the Investment Tax Credit on passive income; see **Tax Incentives for Historic Buildings** and pamphlet entitled "Preservation Tax Incentives

for Historic Buildings."

Tax Incentives for Historic Buildings - The Tax Reform Act of l986 establishes: (1) a 20% tax credit for the **substantial rehabilitation** of historic buildings for commercial, industrial, and rental residential purposes, and a 10% tax credit for the substantial rehabilitation for nonresidential buildings built before l936 and (2) a straight-line depreciation period of 27.5 years for residential property and 31.5 years for nonresidential property for the depreciable basis of the rehabilitated building reduced by the amount of the tax credit claimed. The 10% tax credit is not available for rehabilitations of **certified historic structures**, and owners who have properties within **registered historic districts** and who wish to elect this credit must obtain certification that their buildings are not historic. See pamphlet entitled "Preservation Tax Incentives for Historic Buildings."

tenon - The projecting end of a piece of wood, or other material, which is reduced in cross section, so that it may be inserted in a corresponding cavity (**mortise**) in another piece in order to form a secure joint (Harris)

tensile strain - The elongation of a material which is subject to tension (Harris).

tensile strength - The resistance of a material to rupture when subject to tension; the maximum **tensile stress** which the material can sustain (Harris).

tensile stress - The stress per square unit area of the original cross section of a material which resists its elongation (Harris).

tension - The state or condition of being pulled or stretched.

terra cotta - Hard, unglazed fired clay; used for ornamental work and roof and floor tile; weighs approximately 120 pounds (lbs.) per cubic foot (1,920 kg per cu m). Also see **architectural terra cotta**.

therapy - The choice of remedial measures (reinforcement, strengthening, replacement, etc.) in response to diagnosis (ISCARSAH). See **anamnesis**, **control**, and **diagnosis**.

TNRICRT - The National Research Institute for Cultural Properties, Tokyo

Time dependent response analysis - Study of the behavior of a structure as it responds to a specific ground motion for each time interval (e.g., per second) that the ground motion takes as it passes through the structure [AIA].

torque - That which tends to produce rotation; the product of a force and a lever arm which tends to twist a body, as the action of wrench turning a nut on a bolt.

torsion - Rotation forces around an axis [AIA]. The twisting of a structural member from a combination of tension, compression, and shear about its longitudinal axis by two equal and opposite **torques**, one at one end and the other at the opposite end (Harris and Krakower).

traditional mortar - Generally a lime and sand or, sometimes a lime, clay and sand, mortar for structures built in the 18th and most of the 19th Centuries. Engineered structures in the 19th Century (ports, canals, locks, etc.) often incorporated natural cement in the mixture. Other additives such as brick dust and lamp black were sometimes incorporated into that mix as colorants. Late 19th and 20th century mortars often contain portland cement with or without lime. Any mortar used on an historic building should match the original mortar in color, texture, strength, hardness, permeability, and profile. New mortar should never exceed the strength and permeability of the existing masonry units, especially soft brick or stone. The use of cement in mortar decreases the permeability of the mortar. By doing so, it may cause soluble salts to crystallize in the brick or stone of a wall if these materials are more permeable than the mortar. Salts are transmitted into a wall through moisture (rain or rising damp) and

crystallize upon evaporation of the moisture. It is important that this evaporation take plate through the joint for preservation of the masonry units. Cement may be added to a lime mortar up to a ratio of 1 part of cement (white portland) to 2.5 parts of lime without greatly reducing the permeability or having the mix be hydraulic. Lower ratios may be used if the original mortar or masonry units warrant (Cliver).

trench - A long and narrow deep trough in the sea floor; interpreted as marking the line along which a plate bends down into a subduction zone [AIA].

truss - A structure composed of a combination of members that resist axial loads usually in some triangular arrangement so as to constitute a rigid framework (Krakower).

thrust (reverse) fault - A fault under compression where the overlying block moves up the dip of the fault plane.

tsunami - A sea wave produced by large areal displacements of the ocean bottom, the result of earthquake or volcanic activity [AIA].

tsunami - A tidal wave occurring as a result of a subocean earthquake. The velocity of a tsunami is related to the depth of the water by the formula V = square root of (Dg), where V is the velocity and D is the depth. A typical period for such waves is 1 h (hour) and for a depth of say 5.6 km (3.5 miles) the velocity would be 800 km/h (497.1 mi/hr). The wave length therefore is about 800 km (497.1 miles). At sea, the tsunami is almost unnoticed and its presence is only noted when it reaches a landmass (*Consulting Engineer,* May l978).

ultimate shear stress - The stress at a section which is loaded to its maximum in shear (Harris).

ultimate strength - Of a material in tension, compression, or shear: the maximum value of tension, compression, or shear, respectively, that the material can sustain without failure (Harris).

UBC - *Uniform Building Code*, published by the International Conference of Building Officials (ICBO)

UCBC - *Uniform Code for Building Conservation*, published by the International Conference of Building Officials (ICBO)

ultrasonic test - the use of ultrasonic waves (frequency greater than 20,000 Hz) to non-destructively characterize a material or object (Atkinson).

underpinning - The rebuilding or deepening of the foundation of an existing building to provide additional or improved support, e.g., additional support required as a result of a new excavation in adjoining property which is deeper than the existing foundation (Harris).

UMB - Unreinforced masonry building.

unreinforced masonry - Masonry constructed with less than the minimum iron or steel reinforcing rods or wire mesh (see current UCBC for requirement) to resist tension or shear forces (Krakower).

unreinforced masonry building - A masonry building constructed with less than the minimum iron or steel reinforcing rods or wire mesh (see current UCBC for requirement) to resist tension and shear forces (Krakower).

URM - Unreinforced masonry.

US/ICOMOS - U.S. Committee/International Council on Monuments and Sites

vault - A masonry covering over an area which uses the principle of the arch (Harris). An arched or curved surface (Krakower).

vaulted plaster ceiling - An arched or curved ceiling constructed of plaster bonded to wood or metal lath attached to the framing of the building (Krakower).

velocity - Rate of change of position, in relation to time.

Venice Charter of l964 - The International Charter for the Conservation and Restoration of Monuments and Sites adopted by the 2nd International Congress of Architects and Technicians of Historic Monuments, which met in Venice May 25-31, l964. This is the document on which the *Secretary of the Interior's Standards for Preservation Projects* is based. For most of the world the Venice Charter is the guiding document for the treatment of historic buildings, structures, sites, and objects (see paper by Kimbro).

vertical truss system - Structural system consisting of a pair of columns connected together with diagonals forming a vertical truss (Fatehi).

viga - Roughly dressed logs used for floor joists or roof rafters in the construction of early adobe buildings (NPS).

viscosity - The internal friction of a fluid, caused by molecular attraction, which makes it resist a tendency to flow (Cliver).

voussoir - A wedge-shaped masonry unit in an arch or vault whose converging sides are cut as radii of one of the centers of the arch or vault (Harris).

vulnerability - The degree of loss that will be sustained by an element from an earthquake of given intensity (Feilden).

wall-anchor shear bolt - An anchorage to a masonry wall that provides a combination of tension capacity and shear capacity (Kariotis).

wainscot - A decorative or protective facing applied to the lower portion of an interior partition or wall, such as marble, wood paneling or other facing material (Harris). The lower part of a wall that is finished with a different material than the rest of the wall (Krakower).

wave - To move back and forth or up and down; a disturbance or oscillation propagated from point to point in a medium or in space and described, in general, by mathematical specification of its amplitude, velocity, frequency, and phase; a graphic representation of a variation of such a disturbance with time.

wave length The distance between successive similar points on two wave cycles [AIA].

web - The portion of a truss or girder between the chords or flanges, whose principal function is to resist shear (Krakower).

wide-flange beam - A structural beam of rolled steel or concrete having a shape whose cross section resembles the letter H; has wider flanges than an I-beam (Harris).

wood sheathing - Wooden boards or planks used for **sheathing**.

working stress - See **allowable stress.**

working stress design - A method of design in which structures or members are proportioned for prescribed working loads at stresses which are well below their ultimate values; linear distribution of flexural stresses is assumed (Harris).

wrought iron - A commercially pure iron of fibrous nature (now difficult to obtain); valued for its corrosion resistance and ductility; used for water pipes, water tank plates, rivets, stay bolts, beams, and forged work.

WSSPC - Western States Seismic Policy Council

wythe, withe - One thickness of brick, approximately 4 inches.

"X"-shear crack - See **diagonal tensile cracking**.

yield, yielding - When the material begins to exhibit plastic behavior.

yield point - The lowest **stress** in a material (less than the maximum attainable stress) at which the material begins to exhibit plastic properties; beyond this point an increase in **strain** occurs without an increase in **stress** (Harris).

yield strength - The **stress** at which a material exhibits a specified limiting deviation from the proportionality of **stress** to **strain** (Harris).

Young's modulus - In an elastic material which has been subject to strain below its elastic limit, the ratio of the tensile stress to the corresponding tensile strain (Harris).